



**Aerospace Medicine  
and Biology**  
A Continuing  
Bibliography  
with Indexes

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(NASA-SP-7011(289)) AEROSPACE MEDICINE AND  
BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH  
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Administration) 70 p

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## ACCESSION NUMBER RANGES

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# **AEROSPACE MEDICINE AND BIOLOGY**

**A CONTINUING BIBLIOGRAPHY  
WITH INDEXES**

**(Supplement 289)**

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in September 1986 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



Scientific and Technical Information Branch  
**National Aeronautics and Space Administration**  
Washington, DC

1986

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# INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 210 reports, articles and other documents announced during September 1986 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

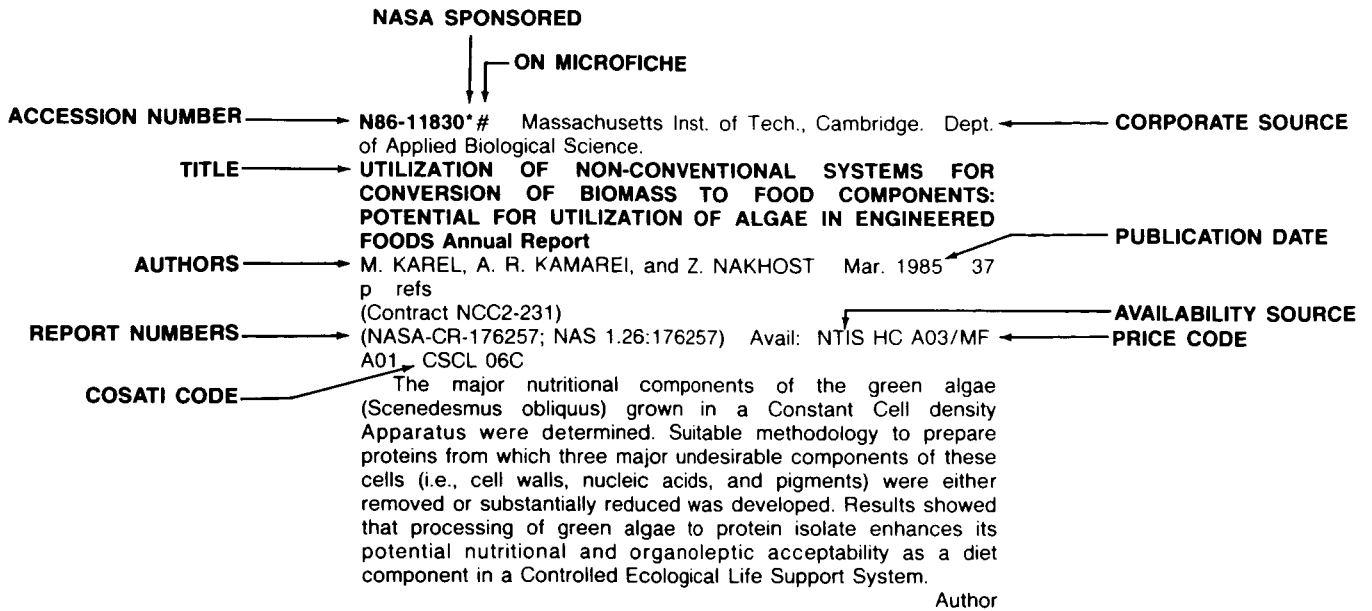
Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1986 Supplements.

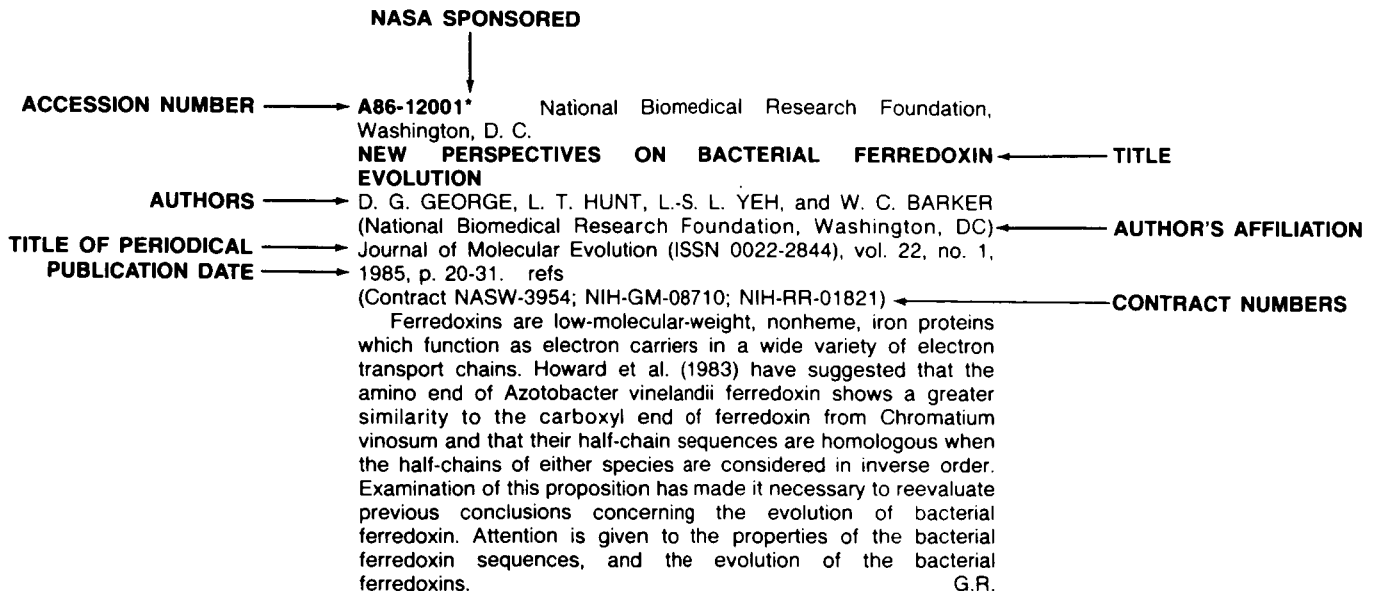
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## TYPICAL REPORT CITATION AND ABSTRACT



## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



# AEROSPACE MEDICINE AND BIOLOGY

*A Continuing Bibliography (Suppl. 289)*

OCTOBER 1986

51

## LIFE SCIENCES (GENERAL)

Includes genetics.

**A86-37855#**

### LIFE SCIENCE OPPORTUNITIES IN THE SPACE STATION

L. R. YOUNG (MIT, Cambridge, MA) IN: International Conference on Space, 25th, Rome, Italy, March 26-28, 1985, Proceedings . Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1985, p. 73-76.

Areas of research in the life sciences are pointed out that could benefit greatly when the facilities of the Space Station become available. Research subjects and problems meriting work include: human physiology (cardiovascular system deconditioning, loss of bone minerals, loss of muscle mass, vestibular system reaction to weightlessness); gravitational biology; and the study of the origin and evolution of life on earth. Some facilities that will be needed to conduct this research are mentioned, in particular the variable g centrifuge for use by various disciplines and capable of handling humans as well as animals and plants. D.H.

**A86-38146**

### THE PRECAMBRIAN EVOLUTION OF TERRESTRIAL LIFE

A. H. KNOLL (Harvard University, Cambridge, MA) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984 . Dordrecht, D. Reidel Publishing Co., 1985, p. 201-211. refs  
(Contract NSF BSR-82-13682)

**A86-38147\*** Chicago Univ., Ill.

### SOME IMPLICATIONS OF MASS EXTINCTION FOR THE EVOLUTION OF COMPLEX LIFE

J. J. SEPKOSKI, JR. (Chicago, University, IL) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984 . Dordrecht, D. Reidel Publishing Co., 1985, p. 223-232. refs  
(Contract NAG2-282)

Extinction has the destructive effect of eliminating established lineages from an evolutionary system, and the constructive effect of vacating ecospace into which new lineages can evolve. Mass extinctions, which are times of unusually intense extinction, have been consistently followed by major radiations of new lineages. Extraterrestrial impacts associated with extinction events and a periodic recurrence of these events implicates an extraterrestrial forcing mechanism as the ultimate cause of mass extinction. This suggests that the extraplanetary environment has played an important, active role in the development of complex life on earth. Author

**A86-38149**

### UNIVERSAL ASPECTS OF BIOLOGICAL EVOLUTION

J. A. BALL (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984 . Dordrecht, D. Reidel Publishing Co., 1985, p. 251-254.

The question of universal biology is addressed and the following points are discussed in detail: (1) the concept of progress can be defined in a fairly precise way; (2) the earth's fossil record shows that progress has occurred; (3) even after Darwin, the reason why is hardly understood; (4) the problem can be approached by considering the differential survival of replicators called genes and memes, and (5) an extrapolation of the trend predicts continued progress for earth's biosystem and presumably for other civilizations. It is concluded that what is needed is a unified general theory that contains Prigogine's dissipative structures in non-equilibrium thermodynamics, the origin of life and biological systems from nonliving material, Darwinian evolution by mutation and natural selection of replicators, and progress through accumulation of information in hierarchial structures up through civilizations, all as special cases or corollaries. Such a theory would define a level-of-development parameter for a system in terms of its useful information or instruction content. It would also define progress as an increase in the level of development, and then it would specify the conditions under which progress may or may not take place. K.K.

**A86-39096**

### HEMODYNAMICS OF MINIATURE SWINE DURING +GZ STRESS WITH AND WITHOUT ANTI-G SUPPORT

J. W. BURNS, M. J. PARNELL, and R. R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) Journal of Applied Physiology (ISSN 0161-7567), vol. 60, May 1986, p. 1628-1637. refs

The relation between venous flow (VF), head-level arterial blood pressure, and increasing +Gz is examined. Nine, female miniature swine weighing between 31.0-56.0 kg are subjected to head-to-tail inertial load levels of +3, +5, and +7 Gz for 60 sec, with and without anti-G-suit inflation. An inserted probe and catheter were used to measure VF, central venous pressure (CVP), abdominal venous pressure (AVP), eyelevel blood pressure (ELBP), and esophageal pressure. A decrease in ELBP from control of 75, 113, and 160 pct without G-suit inflation and of 50, 65, and 98 pct with G-suit inflation for +3 Gz, +5 Gz, and +7 Gz, respectively is recorded; VF decreases from control by 41, 48, and 64 pct without G-suit inflation and by 20, 31, and 39 pct with G-suit inflation at increasing Gz levels. The effects of an anti-G-strain maneuver on the cardiovascular system is investigated; increases in the continuous AVP-to-CVP gradient and the VF are observed during no strain and increasing +Gz. The data reveal VF occurs at all +Gz levels with and without G-suit support and there is no correlation between the decrease in VF and the increase in ELBP during +Gz. I.F.



A86-39097

**EXERCISE CONDITIONING INCREASES RAT MYOCARDIAL CALCIUM UPTAKE**

S. N. LEVINE and G. T. KINASEWITZ (Louisiana State University, Medical Center, Shreveport) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1673-1679. Research supported by the American Heart Association. refs  
(Contract NIH-HL-27999)

A86-39470\* California Univ., Santa Barbara.

**ARE INTERPRETATIONS OF ANCIENT MARINE TEMPERATURES CONSTRAINED BY THE PRESENCE OF ANCIENT MARINE ORGANISMS?**

J. W. VALENTINE (California, University, Santa Barbara) IN: The carbon cycle and atmospheric CO<sub>2</sub>: Natural variations archaic to present; Proceedings of the Chapman Conference on Natural Variations in Carbon Dioxide and the Carbon Cycle, Tarpon Springs, FL, January 9-13, 1984. Washington, DC, American Geophysical Union, 1985, p. 623-627. refs  
(Contract NSF EAR-81-21212; NAG2-73)

The relationship between marine temperature and marine organisms is investigated. The adaptation of organisms to extreme temperatures is studied; it is observed that chemotrophic and chemoheterotrophic prokaryotes adapt to 100 C, photoautotrophic prokaryotes to 73 C, and fungi to 60 C. The physiological and molecular factors related to thermal limits in organisms such as enzymes, lipids, or plasma membranes, are examined. Two types of thermal adaptations, resistance and capacity, are detected in organisms. Reasons for species distributions according to temperature barriers are proposed by Read (1967) and Bullock (1955) and are related to enzyme limits. The effects of an organism's composition on thermal stability is analyzed. I.F.

A86-39718

**CYCLIC ADENOSINE-3',5'-MONOPHOSPHATE AND CYCLIC GUANOSINE-3',5'-MONOPHOSPHATE IN THE BLOOD PLASMA OF MICE INJECTED WITH CHEMICALS OF DIFFERENT RADIOPROTECTIVE EFFICIENCY [TSIKLICHESKIE ADENOZIN-3',5'-MONOFOSFAT I GUANOZIN-3',5'-MONOFOSFAT V PLAZME KROVI MYSHEI PRI VVEDENII KHIMICHESKIKH SOEDINENII, OBLADAUSHCHIKH RAZLICHNOI PROTIVOLUCHEVOI EFFEKTIVNOST'IU]**

A. N. KOTEROV, A. V. NIKOLSKII, V. P. BEKETOV, and N. B. PUSHKAREVA (Institut Biofiziki, Moscow, USSR) *Radiobiologiya* (ISSN 0033-8192), vol. 26, Mar.-Apr. 1986, p. 195-200. In Russian. refs

A86-39719

**CHANGES IN THE CARBOHYDRATE ENERGY METABOLISM IN THE RAT BRAIN UNDER LASER RADIATION [IZMENENIIA UGLEVODNO-ENERGETICHESKOGO OBMENA V GOLOVNOM MOZGE KRYSA PRI LAZERNOM OBLUCHENII]**

A. T. PIKULEV, T. N. ZYRIANOVA, M. F. KUKULIANSKAIA, V. M. LAUROVA, S. I. MOKHOREVA (Belorusskii Gosudarstvennyi Universitet, Minsk, Belorussian SSR) et al. *Radiobiologiya* (ISSN 0033-8192), vol. 26, Mar.-Apr. 1986, p. 205-208. In Russian. refs

A86-39720

**AN ANAEROBIC SHIFT IN ENERGY METABOLISM IN THE MOUSE BRAIN DURING RECOVERY FROM ACUTE RADIATION SICKNESS [ANAEROBNIY SDVIG ENERGETICHESKOGO OBMENA V GOLOVNOM MOZGE MYSHEI V VOSSTANOVITEL'NOM PERIODE OSTROI LUCHEVOI BOLEZNI]**

A. V. POPOV, L. A. KOZHEMIKIN, and I. U. IVNITSKII (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) *Radiobiologiya* (ISSN 0033-8192), vol. 26, Mar.-Apr. 1986, p. 235-237. In Russian. refs

A86-39721

**THE MECHANISMS OF THE EFFECT OF NONIONIZING RADIATION ON AN ORGANISM'S SENSORY SYSTEMS [K VOPROSU O MEKHAZIMAKH DEISTVIA NEIONIZIRUIUSHCHIKH IZLUCHENII S ZHIVYM ORGANIZMOM NA UROVNE SENSORYNYKH SISTEM]**

A. A. ARIFULIN, M. S. BURENKOV, A. V. DAVIDENKO, V. I. PICHUGIN, R. M. SALIMOV (Institut Biofiziki, Moscow, USSR) et al. *Radiobiologiya* (ISSN 0033-8192), vol. 26, Mar.-Apr. 1986, p. 247-250. In Russian. refs

The effect of electromagnetic radiation (EMR) on the function of the central nervous system was studied in rats and mice. In rats, exposure to microwave radiation for 10 min led to a lowering of the EEG response to rhythmic photostimulation, due to sensory interference. The role of cutaneous receptors in the sensory effects of microwaves was studied in mice subjected to 5 min of EMR alone or to EMR following (by two weeks) an exposure to low intensity ionizing radiation (from Co-60). Both EMR and gamma rays separately led to a significant and equal increase in the measured response to cold while the combination of both types of radiation led to a cancellation of the observed increases. The role of skin receptors in the sensory changes effected by EMR is discussed. I.S.

A86-39722

**THE EFFECT OF RADIATION ON THE CONCENTRATION AND METABOLISM OF DOPAMINE IN THE RAT BRAIN [VLIANIE OBLUCHENIIA NA SODERZHANIE I OBMEN DOPAMINA V GOLOVNOM MOZGE KRYSA]**

V. I. LEGEZA, M. F. KAMYNNINA, I. V. MARKOVSKAIA, and M. G. SHAGOIAN (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) *Radiobiologiya* (ISSN 0033-8192), vol. 26, Mar.-Apr. 1986, p. 262-264. In Russian. refs

N86-26793# Johns Hopkins Univ., Baltimore, Md. School of Medicine.

**MACROPHAGE STRUCTURE AND FUNCTION Final Report, 1 Feb. 1982 - 31 Jan. 1985**

T. AUGUST 19 Dec. 1985 9 p

(Contract N00014-82-K-0221)

(AD-A163314) Avail: NTIS HC A02/MF A01 CSCL 06A

Extensive progress has been made in the identification and characterization of several proteins active in the human immune response. These results are summarized as follows: Preparation of Monoclonal Antibodies; Identification of Cell Proteins; Characterization of the Human Lymphocyte Function Antigen (HLFA); The In Vitro Formation of Multinucleated Giant Cells Induced from Monocytes by Monoclonal Anti-HLA-DR; Antibodies that Inhibit the Mixed Lymphocyte Reaction (MLR). GRA

N86-26794# Office of Naval Research, London (England).

**BIOTECHNICA '85 INTERNATIONAL CONGRESS FOR BIOTECHNOLOGY**

C. E. ZOMZELY-NEURATH 27 Feb. 1986 24 p Congress held in Hannover, East Germany, 8-10 Oct. 1985

(AD-A165415; ONRL-C-13-85) Avail: NTIS HC A02/MF A01

CSCL 06A

The First International Congress and Exhibition, Biotechnical '85, which took place from 8 through 10 October 1985 at the Hannover Exhibition Grounds, was designed to provide an insight into the structure and growth potential of the relatively new biotechnology market. The congress, which included exhibitions, seminars, workshops, and panel discussions, focused on the commercial and industrial applications of biotechnology. The congress received support from the European Community because of its emphasis on fostering contacts between industry and academia. Over 170 companies, as well as research institutes and universities from 15 countries, disseminated information about current developments in research, laboratory equipment, and production techniques. The topics in the scientific program presented at the symposia sessions were divided into three general areas: (1) measurement of process control and development of

models; (2) biocatalyst preparation, utilization, and improvement; and (3) animal and plant cell cultures. GRA

**N86-26795#** Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.

**DEVELOPMENT, GROWTH AND TIME**

P. M. B. VITANYI Aug. 1985 20 p Revised Submitted for publication

(CWI-CS-R8516; B8575498; ESA-86-97007) Avail: NTIS HC A02/MF A01

A simple mathematical model for filamentous growth and development is proposed. The model relates stereotype elemental (cellular) behavior to empirically observed overall growth curves. The sigmoidal growth curves are obtained. The separation of subjective or physiological time of the organism from objective or absolute, and the relation between them are emphasized. The underlying philosophy is related to Lindenmayer's developmental model. ESA

**N86-26796** Washington Univ., Seattle.

**THE ROLE OF THE OCEANS IN THE ATMOSPHERIC CYCLE OF CARBONYL SULFIDE**

J. E. JOHNSON 1985 111 p

Avail: Univ. Microfilms Order No. DA8529909

The magnitude of the global air-sea flux of carbonyl sulfide (OCS) was assessed. Air and seawater concentrations of OCS from the equator to the Aleutian Islands were measured. The Henry's law constant of solubility for OCS was measured in the laboratory for filtered and boiled seawater at three temperatures. These measurements show: (1) the atmospheric concentration of OCS is very constant and the latitudinal gradient, if any, is small, with a maximum gradient of 7% between 50 deg N and the equator; (2) the ocean surface layer is supersaturated with OCS and is therefore a source for the atmosphere instead of a sink; (3) there appears to be a subsurface maximum in the OCS concentration in the oceanic mixed layer in tropical waters; (4) values for the solubility of OCS in seawater are 10% lower than reported elsewhere; (5) a history of measurements of atmospheric OCS by four groups shows that any secular trend in atmospheric OCS is less than 3%/yr; (6) the budget for atmospheric OCS is still not well understood. Dissert. Abstr.

**N86-27864\*#** Management and Technical Services Co., Washington, D.C.

**USSR SPACE LIFE SCIENCES DIGEST, ISSUE 6**

L. R. HOOKE, ed., M. RADTKE, ed., R. TEETER, ed., and J. E. ROWE, ed. Washington NASA Jun. 1986 131 p

(Contract NASW-3676)

(NASA-CR-3922(07); NAS 1.26:3922(07)) Avail: NTIS HC A07/MF A01 CSCL 06C

This is the sixth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 54 papers recently published in Russian language periodicals and bound collections and of 10 new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. Additional features include a table of Soviet EVAs and information about English translations of Soviet materials available to readers. The topics covered in this issue have been identified as relevant to 26 areas of aerospace medicine and space biology. These areas are adaptation, biospherics, body fluids, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, exobiology, genetics, habitability and environment effects, health and medical treatment, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, morphology and cytology, musculoskeletal system, neurophysiology, nutrition, perception, personnel selection, psychology, radiobiology, reproductive biology, and space medicine. Author

**N86-27865#** Electrotechnical Lab., Ibaraki (Japan).

**STUDIES ON INFORMATION PROCESSING MECHANISMS IN THE CENTRAL VISUAL SYSTEM OF THE CAT**

S. KAJI Dec. 1985 42 p

(EL-861; ISSN-0366-9106; UDC-572.788.916.3) Avail: NTIS HC A03/MF A01

The characteristics of information processing of visual neurons were investigated, including nonlinear summation and contour enhancement effects of concentric receptive fields, and neural interactions between detectors for the same or different stimulus domains. A model was proposed to explain the results of antagonistic actions between the center and surrounding regions in the concentric receptive field of lateral geniculate neurons. The response of lateral geniculate neurons with concentric receptive fields to large two-dimensional figures was investigated. The interactions between the different orientation detecting processes were investigated in the orientation sensitive neurons of the visual cortex. The neural interactions between two direction-selective processes as well as between direction and selective process were investigated in the complex type neurons, using a non-oriented textured stimulus (two-dimensional random noise pattern) and an oriented grating. B.G.

**N86-27866#** Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.

**INHALATION TOXICOLOGY. 5: EVALUATION OF RELATIVE TOXICITY TO RATS OF THERMAL DECOMPOSITION PRODUCTS FROM TWO AIRCRAFT SEAT FIRE-BLOCKING MATERIALS Report, Oct. 1983 - Sep. 1984**

D. C. SANDERS, C. R. CRANE, and B. R. ENDECOTT Nov. 1985 16 p

(AD-A165034; DOT-FAA-AM-86-1) Avail: NTIS HC A02/MF A01 CSCL 06T

Two fire-blocking layer (FBL) materials, designed to delay the thermal decomposition of polyurethane foam seat cushions during an aircraft cabin fire, were evaluated for the relative toxicity of their gaseous combustion products. Each material was thermally decomposed under five distinct thermal environments: two contact temperatures (600 and 750 c) in a horizontal hot tube furnace and three flux levels (2.5, 5.0, and 7.5 w/cm) in a radiant heat furnace. The measured toxicological endpoint was time-to-incapacitation (+ sub i) in the albino rat; this endpoint is believed to be the most relevant one for assessing smoke hazard in a fire environment. In three of the five test environments, norfab, an aluminized synthetic fabric, produced shorter + sub i--and was thus toxic--than vonar, a neoprene foam. However, at 2.5 w/cm in the radiant furnace system, the norfab test specimen lost only 13 percent of the sample weight and did not incapacitate any of the test animals during the exposure period and, at 750c (flaming) in the combustion tube assembly, norfab produced longer and more variable + sub i than did vonar. Hydrogen cyanide (hcn) was detected in the combustion products from norfab under all test conditions except the 2.4 w/cm radiant flux level; no HCN was detected in the test conditions except the 2.5 w/+ sub i radiant flux level; no HCN was detected in the combustion products from any of the vonar tests. GRA

**N86-27867#** George Washington Univ., Washington, D.C.

**MICROWAVE EFFECTS ON CNS: A HISTOPATHOLOGIC, ULTRASTRUCTURAL AND AUTORADIOGRAPHIC STUDY Final Report**

E. N. ALBERT 20 Feb. 1986 69 p

(Contract N00014-78-C-0527)

(AD-A165040) Avail: NTIS HC A04/MF A01 CSCL 06R

The objectives of this investigation were to: (1) investigate the effects of electromagnetic fields on the release of calcium ions from nervous tissue, (2) examine for histological changes, if any, of young rat brains after 2.45 GHz microwave exposure, and (3) study the rat brain metabolism during 2.45 GHz microwave exposure using 2-Deoxyglucose. In conclusion, the data presented here demonstrates that the specific radiofrequency radiation used does not perturb Ca ions efflux from avian brain tissue under in vitro conditions. Comparison of this data with that gathered by

Blackman's group, however, suggests that appropriate radiofrequency radiation in conjunction with certain other physical factors may indeed perturb Ca ions efflux. GRA

**N86-27868#** Brookhaven National Lab., Upton, N. Y.  
**LATE BIOLOGICAL EFFECTS FROM INTERNAL AND EXTERNAL EXPOSURE**

W. H. ADAMS 1985 12 p Presented at the Health Physics Society Symposium Hammond, La., 28 May 1985  
(Contract DE-AC02-76CH-00016)  
(DE86-001181; BNL-37087; CONF-8505213-1) Avail: NTIS HC A02/MF A01

Information on late biological effects of radiation was obtained from the long-term medical followup of a small population of Marshallese accidentally exposed to radioactive fallout from a thermonuclear test in 1954. Endocrine data are compatible with a sequence of nonstochastic radiation effects. The ingestion of radioisotopes of iodine produced clinical thyroid hypofunction in children, biochemical evidence of thyroid dysfunction in some adults, thyroid adenomatous nodule formation, and, as a possible indirect effect of thyroid damage, at least two cases of pituitary adenoma. In contrast, the only evidence of a stochastic effect has been a real increase in thyroid cancers among the more highly exposed people of Rongelap, none of whom have evidence of residual disease. While three nonthyroidal cancers which are known to be inducible in humans by external irradiation have been documented in the exposed population, three similar cancers have occurred in an unexposed comparison population of Marshallese. Nonstochastic effects of radiation exposure may be common but subtle. In the Marshallese experience the morbidity of delayed nonstochastic effects far exceeds that of the stochastic. DOE

**N86-27869#** Joint Publications Research Service, Arlington, Va.  
**USSR REPORT: LIFE SCIENCES. BIOMEDICAL AND BEHAVIORAL SCIENCES**

9 May 1986 143 p Transl. into ENGLISH from various Russian articles  
(JPRS-UBB-86-008) Avail: NTIS HC A07/MF A01

Topics on life sciences addressed include: aerospace medicine, agrotechnology, biochemistry, biophysics, biotechnology, epidemiology, food technology, genetics, human factors engineering, immunology, clinical medicine, microbiology, physiology, public health, psychology, radiation biology, and virology.

**N86-27871#** Joint Publications Research Service, Arlington, Va.  
**COMMENTARY ON RESULTS OF BIOLOGICAL SATELLITE PROGRAM**

Y. FABBISHENKO In its USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 2 9 May 1986  
Transl. into ENGLISH from Meditsinskaya Gazeta (Moscow, USSR), 15 Jan. 1986 p 4  
Avail: NTIS HC A07/MF A01

The Kosmos-1667 satellite carried two monkeys and other biological specimens. The experimental animals were employed to gather scientific data which is difficult or impossible to obtain from human subjects. The monkeys were monitored with 20 sensors and provided data on the mechanism of changes in an organism during the period of acute change. B.G.

**N86-27873#** Joint Publications Research Service, Arlington, Va.  
**INFLUENCE OF SHIPBOARD ENVIRONMENTAL FACTORS ON CONDITIONED REFLEX ACTIVITY OF EXPERIMENTAL ANIMALS DURING A LONG VOYAGE**

O. Y. NETUDYKHATKA, A. P. STOYANOV, and V. N. YEVSTAFYEV In its USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 98 9 May 1986  
Transl. into ENGLISH from Fiziologicheskii Zhurnal (Kiev, USSR), v. 31, no. 6, Nov. - Dec. 1985 p 688-691  
Avail: NTIS HC A07/MF A01

The influence of environmental factors encountered on board a ship, with predominance of the noise vibration component, was studied with the conditioned reflex activity of experimental animals.

Experiments were performed on 120 male Wistar white rats during a 90-day voyage of a freighter. The influence of specific shipboard environmental factors was evaluated on the basis of studies on conditioned motor reflexes involving response to a sound signal which preceded application of a mild electric shock by 5 seconds. The changes in the conditioned reflex activity varied with intensity and duration of training. Differences in the avoidance reaction were observed in all groups of animals, indicating an increase in the degree of inhibitory processes in the central nervous system as a result of the influence of the unfavorable sanitary-hygienic factors characteristic for the working spaces in ships. Author

**N86-27877#** Joint Publications Research Service, Arlington, Va.  
**CHANGE OF RNA AND PROTEIN LEVEL IN NEURONS-GLIA SYSTEM UNDER EFFECTS OF HYPERTHERMIA AND HYPOXIA**

L. M. MAMALYGA In its USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 103 9 May 1986  
Transl. into ENGLISH from Izvestiya Akademii Nauk Moldavskoy SSR. Seriya Biologicheskikh i Khimicheskikh Nauk (Kishinev, USSR), no. 5, Sep. Oct. 1985 p 42-47  
Avail: NTIS HC A07/MF A01

Functional and metabolic possibilities of different brain structures, under the effects of hyperthermia, hypoxia, and combinations of both, were studied by cytochemical and morphological methods in experiments performed on Wistar male white rats (weight 160 to 180 g) (age 5 to 6 months). Rats were subjected to simulated altitude of 8200 m, to hyperthermia at 40 C for 75 minutes, or to combined hyperthermia and hypoxia at 8200 m and 40 C for 75 minutes. After the experiment, rats were decapitated without use of anesthesia and RNA level and total and basic proteins in various neuron-glia systems were studied. Separate and combined effects of hyperthermia and hypoxia in the organism produced metabolic and morphological changes in the brain structures studied. Reduction of RNA level and proteins in the neurons under combined effect of hyperthermia and hypoxia decreased their cytoplasm volume; overheating dehydrated the organism, reduced the volume of circulating blood, increased its viscosity, and reduced the hemoglobin level in the erythrocytes. The combined effect of hyperthermia and hypoxia, increasing at different rates, decreased the resistance of the animal to altitude considerably. Author

**N86-27878#** Joint Publications Research Service, Arlington, Va.  
**USSR REPORT: SPACE BIOLOGY AND AEROSPACE MEDICINE, NO. 1, JANUARY - FEBRUARY 1986**

17 Apr. 1986 161 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), no. 1, Jan.-Feb. 1986 94 p  
(JPRS-USB-86-003) Avail: NTIS HC A08

Presented is the translation of a journal on space biology and aerospace medicine published in the USSR. The journal is divided into areas of surveys, experimental and general theoretical research, methods, and brief reports. Some representative topics are: Prospects for using ultraviolet radiation in long term spaceflights; Some human reactions during seven-day antiorthostatic hypokinesia; Effect of diphosphonates on bones of hypokinetic rats; Effect of different doses of ultraviolet radiation on vitamin levels in man; Reproductive capacity of microflora on polymers used in sealed environments; and amino acid spectrum of human blood in the presence of emotional stress.

**N86-27886#** Joint Publications Research Service, Arlington, Va.  
**COLLAGEN, LIPID AND GLYCOGEN CONTENT OF RAT SKELETAL MUSCLES IN RECOVERY PERIOD AFTER 15- AND 30-DAY HYPOKINESIA**

P. P. POTAPOV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 45-48 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 33-35

Avail: NTIS HC A08

On the 15th hypokinetic day, carcass mass, glycogen and lipid content in skeletal muscles decreased while collagen content increased. The content of collagen returned to the norm by the 7th day of the recovery period. By that time the glycogen content increased significantly and a week later decreased noticeably. The content of total lipids and triglycerides was higher than the baseline level on the 15th and 30th days of the recovery period. On hypokinesia day 30 carcass mass and glycogen content decreased while collagen content increased. After 30-day hypokinesia, glycogen significantly increased on the 7th day and returned to the norm by the 60th day of the recovery period. Lipid content was elevated only on the 7th day of the recovery period, and collagen content returned to the norm on the 15th day of the recovery period. Following 15- and 30-day hypokinesia, carcass mass returned to the baseline level by the 30th day of the recovery period.

Author

**N86-27889#** Joint Publications Research Service, Arlington, Va.  
**MORPHOLOGICAL AND BIOCHEMICAL INVESTIGATION OF RAT ADRENOCORTICAL FUNCTION DURING LONG-TERM HYPOKINESIA**

Y. V. VOROTNIKOVA and Y. A. ZAGORSKAYA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 59-65 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 41-45

Avail: NTIS HC A08

Female rats exposed to 3-month hypokinesia were used to study adrenal morphology and plasma corticosterone. Prolonged hypokinesia (60 to 90 days) led to a dissociation between adrenal hypertrophy and lower corticosterone content in plasma. During hypokinesia, rats were also exposed to an additional stress effect, i.e., 5-hour immobilization. This approach showed that in the course of 90-day hypokinesia the adrenal cortex retained its ability to react to an acute stress by an enhanced corticosteroid secretion. Moreover, in response to stress effects of identical strength and duration the experimental adrenals produced more corticosterone than the controls with no structural rearrangement or delipoidization.

Author

**N86-27890#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF DIPHOSPHONATES ON BONES OF HYPOKINETIC RATS**

V. N. SHVETS, A. S. PANKOVA, O. Y. KABITSKAYA, Z. Y. VNUKOVA, and B. V. MORUKOV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 66-72 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 45-49

Avail: NTIS HC A08

The diphosphonate effect on bones was studied in Wistar male rats weighing about 200 g. The rats were kept for 60 days in small size cages where their motor activity was diminished. Every day the rats were given 0.3% solution of 1-hydroxy-ethylene-1,1-diphosphonate (HEDP) containing 9 mg/kg phosphorus. In the course of hypokinetic exposure the rats developed generalized osteoporosis. Histomorphometric measurements demonstrated that the drug did not prevent mineral losses from the tubular bones (humerus, femur). However, the drug led to a complete bone mass recovery in the pelvis and a partial recovery in the sternum. The drug also produced a preventive effect on the population of cells-precursors of osteogenesis, the

number of which decreases significantly during hypokinesia.

Author

**N86-27891#** Joint Publications Research Service, Arlington, Va.  
**EXPERIMENTS WITH DEVELOPING PLANTS ABOARD Salyut-5, Salyut-6 AND Salyut-7 ORBITAL STATIONS**

L. N. KOSTINA, I. D. ANIKEYEVA, and E. N. VAULINA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 73-78 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 53-56

Avail: NTIS HC A08

The experiments with air dry *Crepis capillaris* seeds flown on the spacecraft Soyuz-16 and orbital stations Salyut-5, Salyut-6 and Salyut-7 showed that the number of aberrant cells in the seedlings grown during flight (experimental) and after flight (flight control) was higher than in the ground based control. This number was greater in the experimental seedlings than in the flight controls. The plants *Arabidopsis thaliana* grew from cotyledons to flowers during flight. The seeds developed postflight exhibited a lower fertility and a higher frequency of recessive mutants. The greater number of mutants persisted in the progeny of plants that completed their developmental cycle. Inhibited viability of germs manifested as a reduced germination rate of flown seeds and a premature death of seedlings. In the first postflight generation the lesions produced by large chromosome aberrations were eliminated and the lesions caused by gene mutations and microaberrations were retained.

Author

**N86-27894#** Joint Publications Research Service, Arlington, Va.  
**PHYSICAL ENDURANCE OF RATS DURING INTENSIVE AND REPEATED EXPOSURE TO STATIONARY MAGNETIC FIELD**

L. V. KOKOREVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 92-94 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, Jan. - Feb. 1986 p 61-63

Avail: NTIS HC A08

Variations in physical endurance of rats exposed to a constant magnetic field of 1.6 T for 3 hours a day during 30 days were investigated. The parameter was measured as the time of swimming with a load making 10% of body weight until complete arrest. The rats exposed once, 5 or 15 times showed a longer time of swimming than the controls. On the 30th day of exposure there was no difference between the experimental and control animals. The data obtained suggest that exposure to a constant magnetic field produces a stimulating effect on physical work capacity during the first 15 days.

Author

**N86-27896#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF DIBAZOL AND SOME OF ITS IMIDAZO ANALOGUES ON ANIMAL TOLERANCE TO GRAVITATIONAL ACCELERATIONS AND DYNAMICS OF DEVELOPMENT OF POSTISCHEMIC CEREBROVASCULAR PHENOMENA**

V. K. VERESHCHAGIN and M. D. GAYEVYY *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 100-105 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 67-70

Avail: NTIS HC A08

Anesthetized and nonanesthetized animals were used to study the effect of dibazol and its new imidazo analogs (designated AKS-67 and AKS-87) on animal tolerance to gravitational effects and cerebral ischemia (ligation of both carotid arteries), as well as on systemic arterial pressure and tone of cerebral and peripheral vessels (resistographically) in the postischemic period. The drugs were administered 30 to 90 min before exposure. It was found that in nonanesthetized rats dibazol and AKS-87 increased tolerance to cranio-caudal acceleration and decreased it to caudo-cranial acceleration, whereas AKS-67 produced a distinct protective effect regardless of the vector. In anesthetized rats (bilateral carotid ligation) AKS-67 and AKS-87 increased

acceleration tolerance and dibazolium produced no protective effect. Dibazolium enhanced postischemic hypotension while AKS-67 and AKS-87 delayed or completely arrested it. For aerospace medicine the drug AKS-67 is of particular importance because it increases significantly animal tolerance to acceleration and stabilizes arterial pressure in the postischemic period.

Author

**N86-27897#** Joint Publications Research Service, Arlington, Va.  
**REPRODUCTIVE CAPACITY OF MICROFLORA ON POLYMERS USED IN SEALED ENVIRONMENTS**

N. D. NOVIKOVA, M. I. ORLOVA, and M. B. DYACHENKO *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 106-109 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 71-73

Avail: NTIS HC A08

The main representatives of human autotrophic microflora were examined to identify the microorganisms that can grow and develop on various polymers used in an enclosed interior. Bacteria of the genera *Pseudomonas*, *Proteus* and *Bacillus* were found to be most proliferative. Microbial growth was strongly influenced by environmental parameters of the enclosure and by the chemical structure of the polymer.

Author

**N86-27898#** Joint Publications Research Service, Arlington, Va.  
**RESTRAINT SYSTEM FOR WAKING MACACA MULATTA MONKEYS DURING POSTURAL TESTS**

V. P. MELNICHENKO, M. D. GOLDOVSKAYA, V. P. KOTOV, A. G. POPOV, I. S. KONDAKOVA, and N. V. GORBATENKOVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 110-112 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 73-74

Avail: NTIS HC A08

Postural tests are a convenient model for investigation of the distinctions in physiological functions with changes in body position in relation to the vector of Earth's gravity. Postural tests are difficult to perform on waking *Macaca mulatta* monkeys because of their general motor activity, the level of which depends largely on how the animals are immobilized on the turntable. A restraint system involving the use of a special suit is known. The results of the observations revealed that the system of immobilization must meet the following requirements: it should not cause any pain to the animal and must reduce to a minimum the effect of factors that elicit discomfort; it must provide for a standard position of the monkey on the turntable platform; it must prevent passive displacement of the monkey under the effect of gravity when the turntable is tilted. For this reason, a restraint system was developed, the principal elements of which are an immobilization suit, a device that restricts head movements, a device that restricts the monkey's body movements in orthostatic position. The above system was used in postural tests on monkeys weight 3.5 to 6 kg. The system provided reliable, sparing immobilization of monkeys on the turntable and was convenient to work with.

E.R.

**N86-27900#** Joint Publications Research Service, Arlington, Va.  
**DIRECT SPECTROPHOTOMETRIC METHOD OF ASSAYING AMMONIA CONCENTRATION IN GAS ENVIRONMENT OF SEEDING CHAMBERS**

A. A. POLOVINKIN and A. N. KRAVCHUK *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 120-122 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, Jan. - Feb. 1986 p 78-80

Avail: NTIS HC A08

Toxicologists have been traditionally using colorimetry methods to measure ammonia concentration in the air environment. Colorimetric methods are simple to use, they have rather high sensitivity and accuracy. However, they also have a number of flaws. Use of a spectrophotometric method of assaying ammonia

in an air environment eliminates these flaws. A combined unit was developed and used for measurement of ammonia concentration in the range of 1 to 150 mg/cu m in the atmosphere of seeding chambers in toxicological experiments. The method is based on using the absorption maximum of ammonia at a wavelength of 204.3 nm. Introduction of the device to practical toxicological studies makes it possible to effect continuous monitoring, recording and correction of ammonia content of seeding chambers.

E.R.

**N86-27903#** Joint Publications Research Service, Arlington, Va.  
**INTENSITY OF PHOTOSYNTHESIS IN CLOSTERIOPSIS ACICULAR VAR. AFRICANA HIND AS A FUNCTION OF OXYGEN CONCENTRATION IN THE ATMOSPHERE**

M. A. LEVINSKIKH *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 129-131 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 83-84

Avail: NTIS HC A08

When unicellular algae are included in the photoautotrophic link of closed ecological systems, it is important to know their attitude toward different concentrations of oxygen in the atmosphere. The adverse influence of high concentrations of oxygen on photosynthesis is known as the Warburg effect. The inhibitory effect of high oxygen content on photosynthetic productivity of algae referable to different taxonomic groups has been repeatedly confirmed by many authors. In particular, for a number of *Chlorella* strains it was shown that intensity of photosynthesis, in the case of both cumulative and continuous long term cultivation, is directly related to concentration of oxygen in the gas phase. At the same time, there is information to the effect that some algae can retain productivity when partial oxygen pressure is raised both in the range of 3 to 5 to 21% and up to 40 to 80%. Finally, it was established that the photosynthetic process in *Chlorella sorokiniana* ORS is resistant to oxygen concentrations in the atmosphere of up to 95%. The intensity of photosynthesis in *Closteriopsis acicularis* var. *africana* Hind., family *Ankistrodesmaceae*, as a function of oxygen concentration in the reactor's gas phase was investigated.

Author

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### AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

**A86-39092**  
**EPINEPHRINE-INDUCED CHANGES IN MUSCLE CARBOHYDRATE METABOLISM DURING EXERCISE IN MALE SUBJECTS**

E. JANSSON, P. HJEMDAHL, and L. KAIJSER (Karolinska Sjukhuset; Karolinska Institutet, Stockholm, Sweden) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1466-1470. Research supported by the Karolinska Institutet; Medicinska Forskningsradet. refs

(Contract MF-4494; MF-5930)

**A86-39093**  
**FOREARM SKIN AND MUSCLE VASOCONSTRICTION DURING LOWER BODY NEGATIVE PRESSURE**

A. TRIPATHI (John B. Pierce Foundation Laboratory, New Haven, CT) and E. R. NADEL (Yale University, New Haven, CT) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1535-1541. refs

In view of conflicting reports of skeletal muscle and skin blood flow participation in baroreceptor-mediated reflexes, the effects of graded lower body negative pressure (LBNP) on cutaneous and muscular components of forearm blood flow (FBF) in seven male

subjects at 28 C are studied. FBF was measured by venous occlusion plethysmography and cutaneous flow by laser-Doppler velocimetry, the difference being the muscular flow. Mean FBF decreased by 39 and 56 percent from control at LBNP of 20 and 50 Torr, respectively. Skin flow decreased linearly with graded LBNP contributing 32 percent of the decrease of total blood flow at 20 Torr and then 50 percent of the total decrease of blood flow at 50 Torr. Conversely, the decrease in muscle flow represented 68 percent of the total decrease at LBNP of 20 Torr and then 50 percent of the total decrease at LBNP of 50 Torr. It is concluded that both skin and muscle circulations participate in sustained peripheral vasoconstriction during LBNP, with muscle flow achieving near maximum vasoconstriction by 20 Torr and skin showing a graded vasoconstriction to decreases in LBNP.

Author

#### A86-39094

#### HUMAN THERMOREGULATORY RESPONSES TO COLD AIR ARE ALTERED BY REPEATED COLD WATER IMMERSION

A. J. YOUNG, S. R. MUZA, M. N. SAWKA, R. R. GONZALEZ, and K. B. PANDOLF (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1542-1548. refs

#### A86-39095

#### PULMONARY GAS EXCHANGE IN HUMANS DURING EXERCISE AT SEA LEVEL

M. D. HAMMOND, G. E. GALE, K. S. KAPITAN, A. RIES, and P. D. WAGNER (California, University, La Jolla; California University, Medical Center, San Diego) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1590-1598. refs (Contract NIH-HL-17731; NIH-RR-00827)

Gas exchange in eight male subjects between 22 + or - 1.5 yr during exercise at sea level is studied using the multiple-inert gas-elimination technique. The order of work load is: (1) rest, (2) minimal exercise, (3) heavy exercise, (4) heavy exercise while breathing 100 pct O<sub>2</sub>, (5) rest, (6) moderate exercise, and (7) light exercise. Mixed expired and arterial respiratory and inert gas tensions, cardiac output, heart rate, ventilation, respiratory rate, and blood temperature were measured at rest and during exercise. It is observed that the alveolar-to-arterial O<sub>2</sub> tension difference increases linearly with O<sub>2</sub> uptake revealing a decrease in the efficiency of pulmonary gas exchange. The effect of ventilation-perfusion inequality and diffusion limitation on the increase is analyzed. It is detected that the ventilation-perfusion inequality and diffusion limitation increases during exercise from 0.28 + or - 0.13 to 0.58 + or - 0.30 and 100 pct O<sub>2</sub> breathing does not alter this reaction. The data confirm that increasing ventilation-perfusion inequality and O<sub>2</sub> diffusion limitation occur during heavy exercise at sea level and these changes are independent of the work load order. I.F.

#### A86-39098

#### PHYSIOLOGICAL PROFILE OF WORLD-CLASS HIGH-ALTITUDE CLIMBERS

O. OELZ, H. HOWALD, P. E. DI PRAMPERO, H. HOPPELER, H. CLAASSEN (University Hospital, Zurich; Swiss School for Physical Education and Sports, Magglingen; Centre Medical Universitaire, Geneva; Bern, Universitaet, Switzerland) et al. *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1734-1742. Research supported by the EMDO-Stiftung. refs (Contract SNSF-3,332,78; SNSF-3,128,081; SNSF-3,364,082)

The physiological characteristics of six climbers who had reached an altitude of 8500 m or above without supplemental O<sub>2</sub> are studied 2-12 months after high-altitude exposure. The muscle fiber types, muscle morphometry, maximal aerobic and anaerobic power, ventilation control, oxygen/hemoglobin saturation, and heart rate of the climbers are compared to sedentary controls (SCs) and long-distance runners (LDRs). The maximal O<sub>2</sub> consumption of 60 + or - 6 ml/kg per min, anaerobic power of 28 + or - 2.5 W/kg, muscle types and morphometry, and the ventilatory response of the climbers correlate with SCs and/or LDRs; however, the

HbO<sub>2</sub> pct of the climbers is higher than that of the SCs and LDRs. It is noted that except for higher HbO<sub>2</sub> saturation, high-altitude climbers do not possess physiological characteristics that enhance their adaptation to high altitudes. I.F.

#### A86-39099\* State Univ. of New York, Buffalo.

#### A FUNDAMENTAL PROBLEM IN DETERMINING FUNCTIONAL RESIDUAL CAPACITY OR RESIDUAL VOLUME

J. BOUTELLIER, and L. E. FARHI (New York, State University, Buffalo) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 60, May 1986, p. 1810-1813. (Contract NAS9-16042)

To measure a lung volume that is not directly accessible, one often follows dilution of a single-gas tracer, present initially only in the lung or in a rebreathing bag. The final volume available to the tracer is assumed to be the sum of the two initial components. Since O<sub>2</sub> is taken up and CO<sub>2</sub> is eliminated during the few breaths required for mixing, the total volume changes. The error in lung volume due to this volume change can exceed 10 pct. Theoretical and experimental data is presented to demonstrate the effect of CO<sub>2</sub> and O<sub>2</sub> exchange. A general equation, based on N<sub>2</sub> and Ar, which allows one to circumvent the problems created by these fluxes is introduced. The pitfall of the back-extrapolation approach for a single tracer is shown. Author

#### A86-39598

#### HUMAN BODY IMPEDANCE AND THRESHOLD CURRENTS FOR PERCEPTION AND PAIN FOR CONTACT HAZARD ANALYSIS IN THE VLF-MF BAND

I. CHATTERJEE, O. P. GANDHI (Utah, University, Salt Lake City), and D. WU (East China Normal University, Shanghai, People's Republic of China) *IEEE Transactions on Biomedical Engineering* (ISSN 0018-9294), vol. BME-33, May 1986, p. 486-494. refs (Contract F33615-83-R-0613)

The body impedance and threshold currents for perception and pain in the VLF-to-MF band (10 kHz-3 MHz) obtained from measurements on 367 male and female human subjects in the 18-70 year age range, allowed the calculation of average values and the formulation of valid statistical predictions for the general adult population. Tests using various types of contact simulating contact with different vehicles indicate that human body impedance is inversely proportional to body dimensions, and that the threshold current for perception is proportional to the square of the body dimensions. Results suggest that the 0.3-3 MHz frequency band ANSI guideline 632 V/m is too high for many situations, and that safety devices such as safety shoes and gloves only offer adequate protection up to 1 MHz for VLF, and 4 MHz for MF currents. The human hand/ungrounded van handle contact current flow is shown to be as high as 879 mA, and to produce a local wrist SAR of about 1045 W/kg. R.R.

#### A86-39772

#### FLIGHT FITNESS AND A PAST MYOCARDIAL INFARCTION [APTITUDE AU VOL ET INFARCTUS DU MYOCARDE ANCIEN]

G. LEGUAY, A. SEIGNEURIC (Hopital d'Instruction des Armees Dominique Larrey, Versailles, France), and J. DRONIOU (Hopital d'Instruction des Armees Val-de-Grace, Paris, France) (*Entretiens de Medecine Aerospatiale*, 5th, Le Bourget, France, June 3, 4, 1985) *Medecine Aeronautique et Spatiale*, vol. 25, 1st Quarter, 1986, p. 14-20. In French. refs

Recent advances in diagnostic techniques have led to a reconsideration of the impact of a previous myocardial infarction (MI) on certification for flight fitness. Current practice is to declare pilots who experience an MI permanently unfit for flight duty. An MI is precipitated by an inert fibrous plaque on the contractile myocardium, causing a ventricular dysfunction (VD) and cardiac dysrhythmia (CI). The symptoms are monitored by cavity scintigraphy, echography and angiography (VD) and ECG and scintigraphy (CI). However, only coronorography (CG), performed by an expert, can identify the precise state of health and permit an accurate prognosis. The flight environment, particularly hypoxic conditions, increased catecholamine levels due to increased stresses during takeoff and landing, and dehydration (common



among flight crews) are predisposing factors to MI attacks. Since an MI is only symptomatic of other evolutive conditions, a judgement of unfit for flight duty is thought to be correct unless continued medical monitoring over a period of months reveals a recession in symptoms, accompanied by appropriate changes in life style. Restricted flight duty may then be allowed. The restrictions include the presence of a copilot, the avoidance of hypoxic altitudes and dehydration conditions, and ECG and CI examinations twice a year. M.S.K.

**A86-39773**

**A PRACTICAL ATTITUDE TOWARD VENTRICULAR REPOLARIZATION ABNORMALITIES IN FLIGHT CREWS [ATTITUDE PRATIQUE DEVANT DES ANOMALIES DE LA REPOLARISATION VENTRICULAIRE CHEZ LE PERSONNEL NAVIGANT]**

D. THOMAS, M. KOMAJDA, and Y. GROSGOGEAT (Centre Hospitalier Universitaire La Pitie-La Salpetriere, Paris, France) (Entretiens de Medecine Aerospatiale, 5th, Le Bourget, France, June 3, 4, 1985) *Medecine Aeronautique et Spatiale*, vol. 25, 1st Quarter, 1986, p. 24-28. In French. refs

The results of epidemiological studies of the frequency of repolarization abnormalities (RA) in the general population and in flying personnel are discussed from the point of view of the implications of the RA in the absence of other evidence for coronary problems. For the general population, out of 6786 subjects aged 19-83 yr, 7.9 percent registered RAs. For 8625 RAF personnel, 3.9 percent exhibited variations in the ST segment or the T wave. Other studies have also been performed, and all indicate that the RA data have no significance unless there are other symptoms of ventricular problems. The application of an ECG stress test has been 45 percent effective in detecting the presence or confirming the absence of collateral dysfunctions. However, the ECG stress tests can be a vital aid in identifying other ventricular problems among flight personnel who, if no other abnormalities appear during the test, can be considered healthy and certified fit for flight. Further, more invasive tests are indicated if RAs appear during the stress tests of flying personnel. M.S.K.

**A86-39774**

**NORMAL OR PATHOLOGICAL CORONARY STATUS - REFLECTIONS AND PRACTICAL EXPERIENCES FOR EXPERTISE WITH FLIGHT PERSONNEL [ETAT CORONARIEN NORMAL OU PATHOLOGIQUE? - REFLEXIONS ET INCIDENCES PRATIQUES POUR L'EXPERTISE DU PERSONNEL NAVIGANT]**

M. KOMAJDA, D. THOMAS, and Y. GROSGOGEAT (Centre Hospitalier Universitaire La Pitie-La Salpetriere, Paris, France) (Entretiens de Medecine Aerospatiale, 5th, Le Bourget, France, June 3, 4, 1985) *Medecine Aeronautique et Spatiale*, vol. 25, 1st Quarter, 1986, p. 31-34. In French. refs

The major techniques used in judging the normality or pathology of a coronary artery are reviewed. The performance of many autopsies have demonstrated that coronary stenoses is a function of sex and age. Atherosclerosis may be present at infancy and progress after that point, or may appear in the form of lipidic striations or fibro-muscular plaques and remain clinically latent. Symptoms appear when multiple ulcerations or thromboses occur. Various invasive methods for assessing the degree of coronary stenosis have not proved as useful as myocardial scintigraphy with Thallium 201 for measuring the ventricular flow rates and reserves. The type of pain described by the patient is also important and can aid in the diagnosis of up to 90 percent of the dysfunctions. ECG measurements will only reveal abnormalities if made under stressful conditions. The ECG data, if continued for 24-48 hr, can reveal the presence of problems in ventricular rhythm or fibrillation. These tools are valuable for aerospace medicine in that they permit diagnosing the magnitude of stenosis and the chances that myocardial ischemia or rhythm abnormalities can be precipitated by normal flight duties. Experimental designs are described which could lead to a greater predictive capability for coronary problems. M.S.K.

**A86-39775**

**SLEEP IN AN AEROSPACE ENVIRONMENT [SOMMEIL EN MILIEU AEROSPATIAL]**

J. COLIN. *Medecine Aeronautique et Spatiale*, vol. 25, 1st Quarter, 1986, p. 61-70. In French. refs

The causes and symptoms of sleep disturbances in aerospace environment are discussed. Travel by air or in space disrupts human circadian rhythms by moving people and their physiological rhythms out of synchronization with an external light/darkness cycle and the local time zone. The problem is acute in night and long-duration flights and when confronting wide variations in the day/night period. The loss of synchrony is highest in east-west and west-east flights. Physiological data on the diurnal cycles of various biological and psychological factors are provided to illustrate the behavior of internal clocks, e.g., internal temperature, adrenaline secretions, psychomotor performance, etc., to correspond with the local day/night cycle. Many minimums occur during the normal middle of the night. Resynchronization to a new time arrangement requires a length of time that varies with the individual. Consequently, days, even weeks pass before a person can sleep at a time appropriate to the local environment. Regarding spaceflight, experience in the Gemini program encouraged NASA to schedule astronaut activities in space at times that correspond with the day/night schedule at Cape Kennedy, thereby separating the day/night cycle (90 min) from the place of travel. M.S.K.

**N86-26797\*** National Aeronautics and Space Administration, Washington, D.C.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES**

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(NASA-SP-7011(285); NAS 1.21:7011(285)) Avail: NTIS HC A06/MF A01 CSDL 06E

This bibliography lists 319 reports, articles, and other documents introduced into the NASA scientific and technical information system in May 1986. Author

**N86-26798#** Naval Ocean Systems Center, San Diego, Calif.

**MECHANISM OF ELECTROMAGNETIC ENERGY EFFECTS ON THE NERVOUS SYSTEM: VOLTAGE-CLAMP STUDY Final Report, Oct. 1981 - Sep. 1984**

C. L. BRANDT and N. L. CAMPBELL Jul. 1985 69 p refs  
(AD-A164653; NOSC/TR-1051) Avail: NTIS HC A04/MF A01 CSDL 06R

Low-level microwave energy at a frequency of 2.45 GHz has been previously observed to alter the firing frequency of Aplysia californica neurons. This study was undertaken to search out the mechanism of this microwave effect by examining the influences of microwave energy on specific ion currents across the cell membrane that influence the cell's firing frequency. Late outward K(+) current was examined and showed no statistically significant change during microwave exposure. The membrane current shape during voltage clamping (the summation of several different ionic currents) also showed no change during exposure except in one instance when exposure was concurrent with the application of Na(+) free artificial sea water. GRA

**N86-26799#** Boston Univ., Mass. School of Medicine.

**FLUID-ELECTROLYTE-MINERAL INTERRELATIONS AS AFFECTING WORK PERFORMANCE Final Report, 18 Jun. 1984 - 1 Jul. 1985**

M. JANGHORBANI Nov. 1985 39 p  
(Contract DAMD17-84-G-4012; DA PROJ. 3E1-62777-A-879)  
(AD-A165325) Avail: NTIS HC A03/MF A01 CSDL 06P

This is the Final Report dealing with development of stable isotope approaches for the study of water-electrolyte balance dynamics in relation to exercise in heat. This progress report describes the development of analytical chemistry of labeled water (H<sub>2</sub>O<sup>18</sup>) and rubidium as tracers for the measurement of body water and its dynamics and intracellular mass and its correlates. The methods used in these studies are based on Isotope Ratio Mass Spectrometry (IR/MS) and Inductively Coupled Plasma Mass Spectrometry (ICP/MS). It is shown clearly that both these methods

can be used effectively for simultaneous measurement of body water and body rubidium and their correlates in human adults.

Author (GRA)

**N86-26800#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**PERCEPTUAL AND PHYSIOLOGICAL RESPONSES DURING EXERCISE IN COOL AND COLD WATER**

M. M. TONER, L. L. DROLET, and K. B. PANDOLF 1986 11 p (AD-A165491) Avail: NTIS HC A02/MF A01 CSCL 06S

This investigation examined the interaction of exposure to cold water stress with both perceived exertion and thermal sensation during exercise. Eight male volunteers performed arm, leg and combined arm and leg exercise for 45 min in water at 20 and 26 C. Exercise was performed at a low ( $n = 7$ ) and a high ( $n = 8$ ) intensity relative to the ergometer specific peak oxygen uptake ( $VO_2$  peak). In general, percent  $VO_2$  peak did not differ ( $p$  greater than 0.05) between type of exercise in either 20 or 26 C water. During low intensity exercise when power output was matched across water temperature ( $T_{sub w}$ ), percent  $VO_2$  peak was greater ( $P$  less than 0.05) in 20 C water (52%) compared to 26 C water (42%). Ratings of perceived exertion (RPE) did not differ ( $p$  greater than 0.05) between  $T_{sub w}$ . During high intensity exercise when percent  $VO_2$  peak was matched across  $T_{sub w}$ , RPE was low ( $P$  less than 0.01) during exercise in 20 C ( $X = 12.9$ ) compared to 26C ( $X = 13.9$ ). Multiple correlation analyses comparing both final RPE and thermal sensation (TS) with physiological and thermal measures were performed across type of exercise and  $T_{sub w}$ . These data suggest that the change in oxygen uptake associated with exercise in cold water does not add to the overall perception of exertion. This perception appears to be related to cardiopulmonary variables rather than thermal measures, whereas thermal sensation is related to thermal measures and not cardiopulmonary variables.

GRA

**N86-26801#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Thermophysiology Group.

**INDIVIDUAL PARAMETERS IN THERMOREGULATORY CONTROL; A REVIEW**

G. HAVENITH Dec. 1985 86 p Sponsored by Netherlands Central Organization TNO, Delft (IZF-1985-26; TDCK-86-0429; ESA-86-96943) Avail: NTIS HC A05/MF A01

Variations in human thermoregulatory behavior caused by differences in sex, age, anthropometric measures, hydration state, and circadian rhythm were studied. In order of significance, factors which affect the variations are: state of acclimatization (defined by sweat characteristics); physical fitness (circulatory capacity); hydration state (plasma osmolality and volume); anthropometric measures (body surface, fat, inactive body mass); and time of day.

ESA

**N86-26802#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

**VISUAL PROTECTION AND ENHANCEMENT**

Loughton, England Dec. 1985 230 p refs In ENGLISH and FRENCH Conference held in Athens, Greece, 22-24 Apr. 1985 (AGARD-CP-379; ISBN-92-835-0384-8) Avail: NTIS HC A11/MF A01

Vision is the preeminent sensory channel through which the aviator obtains information necessary for the control of his aircraft and the execution of his operational role. Recognizing this to be important, all reasonable and practical means of enhancing and protecting vision should be adopted. The papers presented considers not only systems for visual protection and enhancement but also addressed the basic physiological and pathological mechanisms underlying existing and future solutions.

**N86-26810#** Army Aeromedical Research Lab., Fort Rucker, Ala.

**AEROMEDICAL LESSONS LEARNED WITH NIGHT VISION DEVICES**

D. R. PRICE and W. E. MCLEAN /n AGARD Visual Protection and Enhancement 10 p Dec. 1985

Avail: NTIS HC A11/MF A01

A review of night vision devices used in the military helicopter flight environment is presented, along with aeromedical lessons learned. Discussion revolves around experience with three U.S. Army aviation systems: the currently used second-generation night vision goggle (NVG), or AN/PVS-5; the soon-to-be-fielded AN/AVS-6 third-generation NVG; and the AH-64 Apache thermal sensor and imaging system. Performance characteristics are presented, and primary emphasis is on aeromedical research related to pilot interface with the systems to include visual acuity, contrast sensitivity, depth discrimination, dark adaptation, crew fatigue, and adaptational problems.

Author

**N86-26812#** Hamburg Univ. (West Germany). Dept. of Ophthalmology.

**PARTICULAR PROBLEMS OF AIRWORTHINESS FROM AN OPHTHALMOLOGICAL VIEW**

J. DRAEGER, K. HANKE, and H. WIRT /n AGARD Visual Protection and Enhancement 3 p Dec. 1985

Avail: NTIS HC A11/MF A01

Navigation of aircrafts depends on visual acuity and optical perception in the main. Therefore ophthalmological evaluation is of major importance in aviation medicine. Each country uses its own national medical standards for the three different pilot classes. But there still remain applicants not exactly meeting these standards. In West Germany, a special expert board is competent for these borderline cases in civil aviation. Some examples are given from the practice of this board showing the particular problems of appropriate decisions. Also the major differences of national regulations between West Germany and the USA are discussed, comparing civil and Air Force standards.

Author

**N86-26814#** Hamburg Univ. (West Germany). Dept. of Ophthalmology.

**NEW GLASSES FOR PRESBYOPIC PILOTS**

J. DRAEGER, H. WIRT, and K. HANKE /n AGARD Visual Protection and Enhancement 3 p Dec. 1985

Avail: NTIS HC A11/MF A01

Presbyopia is a physiological condition starting by an age of about 40 and increasing steadily with age until accommodation ceases around 55. This means that the naked eye is not able to read instruments and charts in near distance. In a fighter cockpit the information of the head-up display is projected on to the windscreen. Therefore, the pilot has to share his attention between infinity and the projected image of the head-up display, focussing and defocussing very quickly between both distances, always looking straight. This reaction slows down with age. In an experimental study an attempt was made to investigate this complex problem and to test certain solutions. A group of untrained presbyopic subjects were asked to perform specifically designed tasks of assembling small parts and were fitted with different multifocal glasses. In three different ranges and different levels, approximately according to the distance in a cockpit, they had to differentiate and to grasp small electronic elements and to fix them on an electronic plate. The time needed and the mistakes were noted and compared. The evaluation showed much better results for those subjects which had with their glasses the greatest visual field for each specific range and level.

E.R.



**N86-26815#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

**CONTACT LENSES FOR PILOTS AND AIRCREW IN THE SERVICES**

J. K. CLOHERTY *In its* Visual Protection and Enhancement 12 p Dec. 1985

Avail: NTIS HC A11/MF A01

After working for five years in the contact lens department of Moorsfields Eye Hospital in London and after fitting and monitoring forty volunteers in the RAF Aircrew Soft Contact Lens Trial, it is the opinion of the author that high water content soft contact lenses, or silicone lenses, used as extended wear lenses, are the only contact lenses which are suitable in an aircrew service environment. The fitting and monitoring of such lenses must be carried out by experts in the field of contact lenses. Author

**N86-26817#** Letterman Army Inst. of Research, San Francisco, Calif.

**EFFECTS OF BROAD-BANDED EYE PROTECTION ON DARK ADAPTATION**

H. ZWICK, T. A. GARCIA, E. S. BEATRICE, and K. R. BLOOM *In AGARD Visual Protection and Enhancement* 8 p Dec. 1985

Avail: NTIS HC A11/MF A01

Modern combat scenarios require soldiers to perform military tasks under night time conditions. While image enhancement devices are vital to such military performance, unimpaired human night vision retinal mechanisms are essential for performance success. Protection of the human biological sensor is of utmost importance. In this investigation, earlier findings indicating that sunglasses could prevent deleterious effects of bright light on dark adaptation are reexamined. It was found that the use of broad band attenuating spectacles could improve absolute visual thresholds but they had minimal effect on central retinal mechanisms. Dark adaptation functions measured with long wavelength light showed no significant sunglass effect; whereas, such functions measured with intermediate spectral light decreased in final visual thresholds. These differential effects were obtained under environmental light conditions insufficient to produce an evaluation in final visual thresholds for control group subjects not provided with sunglasses. The results strongly support previous arguments for providing standard visible and near ultraviolet protection to personnel required to perform military tasks under extremely bright environmental light. Author

**N86-26818#** School of Aerospace Medicine, Brooks AFB, Tex.

**EYE PROTECTION AGAINST INTENSE LIGHT SOURCES**

D. N. FARRER *In AGARD Visual Protection and Enhancement* 3 p Dec. 1985

Avail: NTIS HC A11/MF A01

The assessment of modern techniques for the protection of the eyes against laser radiation must begin with the careful evaluation of these stimuli within the context of impairment of useful work. Occupational safety and health standards were designed to define exposure limits of laser systems to prevent damage. However, an eye hazard may not exist within some exposure conditions (e.g., glare, dazzle, or reversible scotoma) in which functional vision impairment could result in job performance failures. Additionally, eye protection devices should not induce impairment properties. It is within this context that this research program was designed. The identification of laser threats, effects on functional vision and eye protective device properties are important considerations for successful aircrew performance. The vast array of intense light sources which represent threats to functional vision, introduces significant challenges for this research area. Author

**N86-26819#** WWDBw ABC-Schutz, Munster (West Germany).

**CALCULATIONS ON TECHNICAL REQUIREMENTS FOR PROTECTION DEVICES AGAINST A NUCLEAR LIGHT FLASH**

W. REHMANN and H. SESTERHENN *In AGARD Visual Protection and Enhancement* 11 p Dec. 1985

Avail: NTIS HC A11/MF A01

Preliminary calculations on the requirements for protective devices against permanent retinal burns caused by nuclear detonations were based on a simplified model which was also used for this study. Computations concerning the reversible flash blindness of flight crews caused by a nuclear explosion is studied as well as the resultant technical requirements to be met by antflash eye protection systems. In the low yield nuclear range the computations led to shutter times which are technically unfeasible at the present time. Therefore, additional computations were made to determine the periods of blindness occurring when technically feasible antflash eye protection systems are used. They were then compared with the periods of blindness to be expected under identical conditions but without antflash eye protection systems. Author

**N86-26821#** Naval Air Development Center, Warminster, Pa. Life Sciences Research Group.

**THE APPLICATION OF DIFFRACTION OPTICS TECHNIQUES TO LASER EYE PROTECTION**

G. T. CHISUM *In AGARD Visual Protection and Enhancement* 4 p Dec. 1985

Avail: NTIS HC A11/MF A01

Development of a method of protecting the eyes of military personnel from laser radiation has been pursued for a number of years. The devices developed have marginal acceptability, particularly for aircrew personnel. Efforts underway to develop a holographic diffraction grating protection device indicate that such a device is feasible and that the requirements of high transmittance, multiple wavelength rejection and configuration suitable for aircrew use can be met. Author

**N86-26822#** Letterman Army Inst. of Research, San Francisco, Calif.

**FOVEAL FLASHES AND HUMAN PERFORMANCE**

D. I. RANDOLPH, E. T. SCHMEISSER, and E. S. BEATRICE *In AGARD Visual Protection and Enhancement* 6 p Dec. 1985

Avail: NTIS HC A11/MF A01

The role of several variables in the production of a flash which would reduce the ability of humans to detect and discriminate targets, functions which are required of both air and ground troops is determined. Four volunteers were exposed to xenon gas discharge tubes with different retinal spot sizes and flash durations. The task consisted of a reaction time experiment in which the subjects detected both the presence and orientation of a striped grating which subtended 0.57 deg at the retina. Three grating contrasts at three pattern-background contrasts were presented in a pseudo random order. Three flash conditions were used. The results showed that the larger image size and longer flash durations produced significantly poorer performance on both the detection and discrimination tasks. For the smallest retinal spot size, and the shortest flash condition, the detection but not the discrimination times were faster than the nonflash trials. This indicated that while the flash may have acted as a preparatory signal, more complex pattern processing remained sensitive to the flash. Author

**N86-26823#** Letterman Army Inst. of Research, San Francisco, Calif.

**PERMANENT VISUAL CHANGE ASSOCIATED WITH PUNCTATE FOVEAL LESIONS**

H. ZWICK, K. R. BLOOM, and E. S. BEATRICE *In AGARD Visual Protection and Enhancement* 8 p Dec. 1985

Avail: NTIS HC A11/MF A01

In order to understand battlefield hazards of laser exposure under field conditions, it has been necessary to evaluate effects of small punctate foveal lesions on visual function of nonhuman primates. Previous experiments have found a correlation between functional loss and foveal damage. The present investigation

showed that detecting the effects of small foveal lesions is not an easy task. From the results, the possibility that considerable foveal damage could occur before a measurable change in visual function could be detected with presently available visual function testing procedures is apparent. It is recommended that more sensitive visual function test procedures, such as clinical tests that measure both spectral and spatial resolution under threshold contrast conditions. Author

**N86-27870#** Joint Publications Research Service, Arlington, Va.  
**LACTOBACTERIA AND PROPHYLAXIS IN SPACE**

I. IVANOV *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 1 9 May 1986 Transl. into ENGLISH from Tass (Tartu, USSR), 11 Mar. 1986  
Avail: NTIS HC A07/MF A01

Cosmonauts on long duration space flights face health hazards in the form of pathogenic bacteria. Lactobacteria increase the resistance of the body to disease and kill agents responsible for many diseases. The lactobacteria have the capacity to stick to the cell of the human body and thus make them invulnerable to pathogenic microbes. The lactobacteria preparation replenishes the loss of the bacteria in the human body and stimulates the immune system. The use of these microorganisms institutes an ecological barrier protecting man. B.G.

**N86-27872#** Joint Publications Research Service, Arlington, Va.  
**SWEATING REFLEX IN COMPLEX OF METHODS FOR EVALUATING OPERATOR EFFICIENCY**

P. P. SLYNKO, L. I. BUKVAREVA, S. V. ZAPOROZHETS, and P. M. ONISHCHENKO *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 46 9 May 1986 Transl. into ENGLISH from Fiziologicheskii Zhurnal (Kiev, USSR), v. 31, no. 6, Nov. - Dec. 1985 p 678-682 Original language document was announced as A86-21453  
Avail: NTIS HC A07/MF A01

A method for measuring the electrodermal characteristics associated with the stress induced diaphoretic reflex was developed. The method is intended for use in evaluating the functional conditions of a human operator in monotonous work conditions. A general description of the diaphoretic skin sensor is given, and experimental results are presented concerning the accuracy of the method in comparison to conventional electrodermal sensing methods. It is shown that, in contrast to conventional methods, the present sensing method offers a highly reliable measure of skin response over extended periods of monotonous work. I.H.(IAA)

**N86-27874#** Joint Publications Research Service, Arlington, Va.  
**EFFECTS OF COLD EXPOSURE ON THERMAL STATUS OF MEN AND WOMEN**

R. F. AFANASYEVA and R. O. OGANYAN *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 100 9 May 1986 Transl. into ENGLISH from Gigiyena Truda i Professionalnyye Zabolevaniya (Moscow, USSR), no. 1, Jan. 1986 p 24-28  
Avail: NTIS HC A07/MF A01

Sex differences in thermal comfort perception and objective changes in skin temperature and heat loss on exposure to different environmental temperatures were assessed in 8 men and 9 women between the ages of 20 and 35 years. In conjecture with the objective data that thermoregulation in women relies essentially on physical factors (decreased skin temperature and diminished body heat loss), women were quicker to perceive thermal discomfort. In men, thermal homeostasis relied preferentially on chemical thermoregulation reflected in greater heat loss. B.G.

**N86-27875#** Joint Publications Research Service, Arlington, Va.  
**STUDY OF BRAIN BIOCHEMISTRY DURING HYPOTHERMIA**

E. E. EMIRBEKOV and S. P. LVOVA *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 101 9 May 1986 Transl. into ENGLISH from Kriobiologiya (Kiev, USSR), no. 1, 1985 p 44-49  
Avail: NTIS HC A07/MF A01

Aspects of cerebral metabolism in hibernating and non-hibernating animals during hypothermia are discussed and analyzed on the basis of literature survey. Existing factual materials on neurochemical changes in the brain due to hypothermia cannot support formulation of a fully developed theory of the effect of cooling on cerebral metabolism. There are many gaps in the area of neuro-specific components and their role in hypothermia. A specific concept of the effect of hypothermia on molecular processes in the brain is described briefly. Existence of reserve possibilities of regulatory processes in the central nervous system during hypothermia is indicated and prospects are presented for extending resistance of warm blooded animals to hypothermia by use of adaptive functions at low body temperatures. Author

**N86-27876#** Joint Publications Research Service, Arlington, Va.  
**SOMATOSENSORY AND AUDITORY PERCEPTION ACCORDING TO STUDY USING FOCUSED ULTRASOUND**

Y. M. TSIRULNIKOV *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences (JPRS-UBB-86-008) p 102 9 May 1986 Transl. into ENGLISH from Zhurnal Evolyutsionnoy Biokhimii i Fiziologii (Leningrad, USSR), v. 21, no. 6, Nov. - Dec. 1985 p 591-596  
Avail: NTIS HC A07/MF A01

Materials from literature are used in discussion of aspects of the interpenetration of physiology and psychology in the area of sensory perception with emphasis on the contribution of somatosensory and auditory systems with the aid of focused ultrasound. Characteristics of distribution of sensitivity in the skin surface and in deep tissues are described and discussed. Specific feature of sensitivity in biologically active points are considered. The advisability of isolating elementary sensation and considering its role in formation of a sensory image was indicated. Artificial formation of samples, especially single-model samples such as tactile, temperature or auditory modes was found to be helpful since such a model can be controlled to a great degree with the aid of focused ultrasound and other artificial stimuli. Author

**N86-27879#** Joint Publications Research Service, Arlington, Va.  
**PROSPECTS FOR USING ULTRAVIOLET RADIATION IN LONG-TERM SPACEFLIGHTS**

N. Y. PANFEROVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 1-13 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 4-12  
Avail: NTIS HC A08

The data concerning UV-effects on the human body and the environment are reviewed as applied to long term flights. It is concluded that UV-radiation can be used in long term spaceflights in view of its vitamin forming, desensitizing, bactericidal and supporting properties to improve the environment and to prevent adverse effects of spaceflight factors. Author

**N86-27880#** Joint Publications Research Service, Arlington, Va.  
**EXPERIMENTAL AND GENERAL THEORETICAL RESEARCH: NATURE OF CIRCULATORY REGULATION IN PILOTS**

V. G. DOROSHEV, Z. A. KIRILLOVA, and A. P. VANARSHENKO *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 14-18 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 12-15  
Avail: NTIS HC A08

Dynamic observations over a group of pilots within a working week during three months have shown that blood pressure increases to meet the requirements via higher cardiac output. When

stresses grow and fatigue sets in, the pattern of circulation regulation changes so that elevated blood pressure is maintained due to an increased peripheral resistance. Differential approach to the pattern of blood pressure regulation makes it possible to assess the degree of circulation adaptation to various work loads. Author

**N86-27882#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF INTENSIVE OPERATOR WORK ON LIPID PEROXIDATION PROCESSES IN MAN**

S. M. IVANOVA, O. N. ORLOV, S. S. BRANTOVA, O. I. LABETSKAYA, N. A. DAVYDOVA, A. Y. ZEZEROV, and A. S. USHAKOV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 25-28 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 20-22  
 Avail: NTIS HC A08

It was demonstrated that the stress associated with an active mental work for 2 hours leads to a high rate of lipid peroxidation which results in a greater amount of products of lipid peroxidation in blood and pentane in exhaled air. Simultaneous measurements of blood catecholamines have shown their significant increase immediately after exposure to the stress effect. It can therefore be concluded that a stress situation enhances lipid peroxidation in the human body. Author

**N86-27884#** Joint Publications Research Service, Arlington, Va.  
**DISTINCTIONS IN HUMORAL CONTROL OF METABOLISM WITH SIMULATION OF SPACEFLIGHT FACTORS**

S. KALANDAROV, V. P. BYCHKOV, I. D. FRENKEL, and G. I. PROSKUROVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 34-38 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 25-28  
 Avail: NTIS HC A08

Hormonal regulation of metabolism was investigated in test subjects of three age groups: group 1 included test subjects of 41 to 50 years old, group 2 test subjects of 50 to 57 years old, and group 3 test subjects of 26 to 33 years old. Test subjects from groups 1 and 2 were exposed to head down tilt as well as linear acceleration of 3 Gz for 1 min and exercises of 450 to 1050 kgm before and after the tilt test. Group 3 test subjects were exposed to neuroemotional stress before, during and after the head down test. Exposure to head down tilt, acceleration and exercises caused adaptive changes in humoral regulation of metabolism in the test subjects of groups 1 and 2. Food supplements given to group 3 test subjects produced a normalizing effect on humoral regulation of metabolism. Author

**N86-27885#** Joint Publications Research Service, Arlington, Va.  
**SOME HUMAN REACTIONS DURING 7-DAY ANTIORTHOSTATIC HYPOKINESIA**

B. F. ASYAMOLOV, V. S. PANCHENKO, V. A. KARPUSHEVA, R. A. BONDARENKO, O. A. VOROBYEV, V. V. ZARITSKIY, V. P. STUPNITSKIY, I. G. POPOV, P. A. LOZINSKIY, and S. M. LEDOVSKOY *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 39-44 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 29-32  
 Avail: NTIS HC A08

Time-course variations in the cardiovascular parameters, vestibulo-autonomic stability, work capacity and nutritional status were measured in 20 male test subjects, aged 19 to 22, who were exposed for 7 days to head down tilt. Beginning with days 3 or 4, new hemodynamic ratios developed that indicated a new level of circulation regulation and adaptation to head down tilt. It appears that blood redistribution towards the head led to an enhanced vestibulo-autonomic stability. Renal excretion of nitrogen increased, reaching the highest level on days 6 to 7. The

investigations allow the conclusion that 7-day head down tilt may cause changes in almost every physiological system. Author

**N86-27887#** Joint Publications Research Service, Arlington, Va.  
**HUMAN CENTRAL HEMODYNAMICS DURING LOWER LIMB DECOMPRESSION**

V. V. RUMYANTSEV and V. Y. KATKOV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 49-52 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 35-37  
 Avail: NTIS HC A08

Experiments were performed to study the effect of leg decompression in the head down position at -15 deg. The method of chronic catheterization was used, pressure was measured in different areas of the cardiovascular system, blood was withdrawn for biochemical analysis. The effect of leg decompression was compared with that of lower body negative pressure. Decompression produced changes in Pressure in Pulmonary (PAP) and Central Venous Pressure (CVP) that were similar in sign but different in magnitude. The decompression induced changes in PAP and CVP were primarily determined by the area of exposure. Using previous data, a nomograph was constructed to evaluate PAP and CVP variations as a function of the decompression mode and site. Author

**N86-27888#** Joint Publications Research Service, Arlington, Va.  
**PHASIC PROCESSES IN KINETICS OF FORMED BLOOD ELEMENTS**

V. V. VERIGO and F. GAUSER *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 53-58 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 38-41  
 Avail: NTIS HC A08

When quantitating blood shifts in response to environmental effects, it is important to take into account the phasic pattern of certain processes. Theoretical considerations and experimental data on the fluctuations of the counts of formed elements have been published. Since the fluctuations cannot be easily detected by experimental methods, they can be investigated using mathematical modeling. A model describing the counts of red blood cells and their precursors in relation to the age structure of the population was developed. Depending on the oxygen requirements and physiological parameters, humoral regulation controls cell proliferation and release into the functioning pool. The model allows for incidental hemolysis as well as for lifetime of red blood cells. Simulation of various processes in the blood system when exposed to unusual environmental effects has shown that some of the processes can be phasic in character. Author

**N86-27892#** Joint Publications Research Service, Arlington, Va.  
**T AND B COMPONENTS OF IMMUNITY IN THE PRESENCE OF ACUTE MOUNTAIN SICKNESS**

M. M. MIRRAKHIMOV, M. I. KITAYEV, R. O. KHAMZAMULIN, A. G. TOKHTABAYEV, and S. M. POGREBITSKIY *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 79-84 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 53-56  
 Avail: NTIS HC A08

Immunological aspects of the adaptation process were investigated in 57 male test subjects that stayed for 30 days at an altitude of 3600 m above sea level. The uneventful development of adaptation was accompanied by a short term decrease in the number and activity of T-lymphocytes. An acute mountain disease led to a distinct deficiency of T-cell immunity which still persisted on test day 30. Besides, the content of zero cells in circulating blood was increased and the blast-transformation reaction of lymphocytes to concavalin A was inhibited. Prior to the ascent the test subjects who were susceptible to the acute mountain

disease showed a lower content of T-lymphocytes and a higher content of zero cells in circulating blood. Author

**N86-27893#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF DIFFERENT DOSES OF ULTRAVIOLET RADIATION ON VITAMIN LEVELS IN MAN**

M. S. BELAKOVSKIY, M. G. YUZHANSKAYA, N. Y. PANFEROVA, L. K. PASTUSHKOVA, O. G. PEREVERZEVA, A. N. SMIRNOVA, I. N. SERGEYEV, and V. B. SPIRICHEV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 85-91 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 56-61 Avail: NTIS HC A08

Exposure of healthy adults to prophylactic doses of UV radiation in the medium and long wavelength spectrum improved metabolism of vitamins A, E and D and increased their content in the body. UV irradiation even in prophylactic doses increased ascorbic acid requirements. Excessive UV radiation produced an adverse effect on the vitamin content. However, the vitamin concentration in blood was not significantly decreased. This can be explained by the adaptation of the human body to UV-irradiation upon a continuous increase of its dosage. Author

**N86-27895#** Joint Publications Research Service, Arlington, Va.  
**RADIOBIOLOGICAL VALIDATION OF QUALITY FACTOR OF PROTONS AND HELIUM IONS**

N. I. RYZHOV and B. S. FEDORENKO *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 95-99 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, Jan. - Feb. 1986 p 63-66 Avail: NTIS HC A08

Reported data and experimental results of measuring the relative biological effectiveness of protons of different energies and helium ions of 4 GeV/nucleon were analyzed to determine quality factors of the major components of cosmic radiations. It is recommended to use quality factors equal to 1.30 to 1.45 for 100 to 730 MeV protons and equal to 1.75 for 9 GeV protons and 4 GeV/nucleon helium ions. It is also suggested to employ them as standards for solving practical problems of radiation safety in spaceflights. Author

**N86-27899#** Joint Publications Research Service, Arlington, Va.  
**METHOD OF DEMONSTRATING CALCIUM IN HUMAN FOOT BY NEUTRON ACTIVATION OF (ALPHA, N)-SOURCES**

V. Y. ZAYCHIK, A. Y. KONDRASHOV, and B. V. MORUKOV *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 113-119 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, Jan. - Feb. 1986 p 75-78 Avail: NTIS HC A08

Bone demineralization during long term exposure to weightlessness and hypokinesia is presently a universally recognized fact. However, it should be noted that quantitatively incomparable results were obtained with use of different methods (X-ray densitometry, photon absorptiometry, X-ray tomography) to determine mineralization of bone. Evidently, this is attributable to the fact that they yield only an indirect estimate of the state of the mineral matrix of bone, since they characterize a parameter inherent in bone tissue as a whole, namely, the degree of absorption of photons of X-ray and gamma ranges of energy. Availability of this information alone does not allow one to draw a strictly quantitative conclusion about one of the important features of the mineral matrix, the concentration of calcium. Recording mesorontgen radiation during exposure of some parts of the skeleton, for example, the calcaneus, to mu-mesons is a promising procedure for development of a method of direct measurement of the main mineral constituents of bone. However, there is still much to be done in this direction, and it is difficult to execute such a measuring method, as well as to make a quantitative interpretation of the obtained results. A description of the in vivo NAA method

for Ca level in the human foot is presented. Special investigations had to be conducted to optimize irradiation conditions and spectrometry, as well as develop special equipment, in order to reach the goal of no more than 0.05 relative total error of each individual measurement with an equivalent dose or no more than 3 rem. E.R.

**N86-27901#** Joint Publications Research Service, Arlington, Va.  
**AMINO ACID SPECTRUM OF HUMAN BLOOD IN THE PRESENCE OF EMOTIONAL STRESS**

T. F. VLASOVA, A. S. USHAKOV, V. P. BYCHKOV, and Y. B. MIROSHNIKOVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 123-125 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 80-82 Avail: NTIS HC A08

The results of assaying the amino acid spectrum of human blood with simulation of stress situations similar to the professional activities of cosmonauts are presented. Methods and results are discussed. Author

**N86-27902#** Joint Publications Research Service, Arlington, Va.  
**BLOOD SERUM ENZYMES DURING 7-DAY WATER IMMERSION**

T. Y. DROZDOVA and Y. G. VETROVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 126-128 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 82-83 Avail: NTIS HC A08

During submersion in water the body is exposed to a number of factors, among which redistribution of blood and lack of load on the locomotor system are rather important. This could affect metabolism of skeletomuscular tissue and parenchymatous organs, analogous to the effect of weightlessness. Investigation of changes in blood serum enzyme spectrum enables the demonstration, with some degree of certainty, the direction of metabolic transformations in different tissues and organs in weightlessness. Author

**N86-27904#** Joint Publications Research Service, Arlington, Va.  
**RADIOPROTECTIVE AND THERAPEUTIC EFFICACY OF CARRAGEENAN AGAINST PROTON RADIATION**

K. S. CHERTKOV, N. I. GVOZDEVA, B. S. FEDORENKO, and Y. Y. PREOBRAZHENSKIY *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 132-135 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 84-86 Avail: NTIS HC A08

Assurance of radiation safety of long term spaceflights is one of the important tasks put to space biology and medicine. In this regard, importance is attributed to refinement of technical equipment, search and development of effective drugs. It is known that the danger of irradiation, mainly from high energy protons, is higher in long term spaceflights. It was deemed desirable to investigate the radioprotective properties of some previously tested radioprotective agents, for example, carrageenan, during exposure to protons. E.R.

**N86-27905\*** National Aeronautics and Space Administration, Washington, D.C.  
**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES**

Dec. 1985 81 p  
 (NASA-SP-7011(278); NAS 1.21:7011(278)) Avail: NTIS HC A05 CSCI 06E

This bibliography lists 237 reports, articles, and other documents introduced into the NASA scientific and technical information system in November 1985. Author

**N86-27906#** Electrotechnical Lab., Ibaraki (Japan).  
**STUDIES ON VISUAL INFORMATION PROCESSING IN RETINAL NEURONS**  
 M. YAMADA Oct. 1985 78 p In JAPANESE; ENGLISH summary  
 (EL-859; ISSN-0366-9106; UDC-612.843:681.3) Avail: NTIS HC A05/MF A01

In the retina a great deal of information is processed. A negative feedback hypothesis in synaptic mechanisms explaining color information processes in retinal neurons was not proved physiologically in spite of being supported by histological findings. In order to know the characteristics of visual information processing, the relationship between photostimulus and electric response of cells, particularly, the response dynamics was investigated. A linear response analysis method was applied to the neural network in a retina. The effects of light adaptation on the waveforms of oscillatory potentials found in photoresponses of rods were examined. The relationship between rod and cone neural pathways was studied. The responses of second neurons to photostimulus at receptor cells was also examined. B.G.

**N86-27907#** Electrotechnical Lab., Ibaraki (Japan).  
**STUDIES ON ACCURATE MEASUREMENTS AND ANALYSES OF HUMAN OLFACTORY EVOKED POTENTIALS**  
 M. TONOIKE Jan. 1986 86 p In JAPANESE; ENGLISH summary  
 (EL-863; ISSN-0366-9106; UDC-612.86:6512.825.5:159.933)  
 Avail: NTIS HC A05/MF A01

Several techniques were developed to measure human olfactory evoked potentials (OEPs). Waveforms of the OEPs were recorded when perceived. Techniques for rejecting the contaminants and preventing various kinds of noise are described. The saturation phenomenon is discussed with respect to the amplitude of OEPs for repeated pulse stimuli. Psychological studies on the scaling structure of odors were performed to compare the waveforms of OEPs with the psychological data of olfaction. Waveform of OEPs for various odorants were measured. The singular value decomposition (SVD) method is applied to analyze the waveforms. The correlation of the response peak of OEPs at 300 milliseconds with the P300 response of the event related potential was discussed. B.G.

**N86-27908#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.  
**ELEMENTS OF RADIATION PROTECTION**  
 M. BELLI, S. FRULLANI, F. V. ORESTANO, and G. CAMPURRA 15 Nov. 1985 101 p In ITALIAN; ENGLISH summary Seminar held in Rome, Italy, 21-23 Nov. 1983  
 (ISS-L-84/7; ISSN-0390-6493; ESA-86-97079) Avail: NTIS HC A06/MF A01

The biological effects of radiation, health effects of radiation, and the physical and medical aspects of radiation protection are discussed. ESA

**N86-27909#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.  
**BIOLOGICAL EFFECTS OF IONIZING RADIATION [EFFETTI BIOLOGICI DELLE RADIAZIONI IONIZZANTI]**  
 M. BELLI In its Elements of Radiation Protection 28 p 15 Nov. 1985 In ITALIAN  
 Avail: NTIS HC A06/MF A01

The processes leading to damage of living cells by ionizing radiation are reviewed. The discussion includes the definitions of relative biological effectiveness and linear energy transfer; a description of the primary processes and the effects on lipids, proteins and DNA; the DNA self-repairing processes; and theories of damaging mechanisms. It is concluded that DNA is the main target for permanent biological damage, which is a function of initial damage and recovery capacity. It is shown that mutation mechanisms where the effect-dose ratios do not show a threshold are relevant to genetic and cancerogenic effects. ESA

**N86-27910#** Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.  
**EFFECTS OF RADIATION HEALTH [EFFETTI SANITARI DELLE RADIAZIONI]**  
 S. FRULLANI In its Elements of Radiation Protection 45 p 15 Nov. 1985 In ITALIAN  
 Avail: NTIS HC A06/MF A01

The measurement of radiation parameters such as relative biological effectiveness and linear energy transfer, and the clinical effects of radiation as dependent of dose and type are reviewed in order to assess criteria for a radiation health policy. Stochastic and threshold effects are discussed. The protective regulations existing in the European Community are examined. It is shown that the dose limits are chosen to give a risk limit of one per thousand per year, that is ten times the amount corresponding to low risk professions. ESA

**N86-27911#** Calabria Univ., Cosenza (Italy).  
**OPERATING RADIATION PROTECTION: PHYSICAL ASPECTS [RADIOPROTEZIONE OPERATIVA: ASPETTI FISICI]**  
 F. V. ORESTANO In Istituto Superiore di Sanita Elements of Radiation Protection 10 p 15 Nov. 1985 In ITALIAN  
 Avail: NTIS HC A06/MF A01

The categories of radiation distinguished by Italian law and the function of the radiation expert required by Italian legislation to check working areas with a radiation hazard potential are examined. The details of the regulations are discussed and the full text of several norms is presented. ESA

**N86-27912#** European Nuclear Energy Agency, Frascati (Italy).  
**OPERATING RADIATION PROTECTION: MEDICAL ASPECTS [RADIOPROTEZIONE OPERATIVA: ASPETTI MEDICI]**  
 G. CAMPURRA In Istituto Superiore di Sanita Elements of Radiation Protection 12 p 15 Nov. 1985 In ITALIAN  
 Avail: NTIS HC A06/MF A01

The duties of medical personnel working with radiation exposed workers are described. The nature of preliminary medical evaluations are explained, showing that the main goal is to determine workers' ability to support radiation risk and to identify as early as possible any pathological condition due to radiation or implying a physiological reduction of radiation resistance. Clinical examinations to be performed are classified and discussed. Italian regulations are included. ESA

**N86-27913\*#** Arizona Water Resources Research Center, Tucson. Dept. of Physiology.  
**EFFECTS OF MUSCLE ATROPHY ON MOTOR CONTROL Final Technical Report, 1 Jun. 1982 - 31 May 1985**  
 D. G. STUART 1985 22 p  
 (Contract NAGW-338)  
 (NASA-CR-177201; NAS 1.26:177201) Avail: NTIS HC A02/MF A01 CSCL 06P

As a biological tissue, muscle adapts to the demands of usage. One traditional way of assessing the extent of this adaptation has been to examine the effects of an altered-activity protocol on the physiological properties of muscles. However, in order to accurately interpret the changes associated with an activity pattern, it is necessary to employ an appropriate control model. A substantial literature exists which reports altered-use effects by comparing experimental observations with those from animals raised in small laboratory cages. Some evidence suggests that small-cage-reared animals actually represent a model of reduced use. For example, laboratory animals subjected to limited physical activity have shown resistance to insulin-induced glucose uptake which can be altered by exercise training. This project concerned itself with the basic mechanisms underlying muscle atrophy. Specifically, the project addressed the issue of the appropriateness of rats raised in conventional-sized cages as experimental models to examine this phenomenon. The project hypothesis was that rats raised in small cages are inappropriate models for the study of muscle atrophy. The experimental protocol involved: 1) raising two populations of rats, one group in conventional (small)-sized cages and the other group in a much larger (133x) cage, from weaning age (21 days)

through to young adulthood (125 days); 2) comparison of size- and force-related characteristics of selected test muscles in an acute terminal paradigm. Author

**N86-27914#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CONCERNING BAROTRAUMA OF THE LUNGS-TRANSLATION**  
G. KHRISTOV 5 Feb. 1986 20 p Transl. into ENGLISH from Khirurgiya (Bulgaria), v. 22, no. 6, 1969 p 589-597  
(AD-A165006; FTD-ID(RS)T-1143-85) Avail: NTIS HC A02/MF A01 CSCL 06E

The popularization and development of skin diving has led to the appearance of a new type of trauma of the lungs, caused by rapid change in air pressure in the lungs during sudden ascent of the diver with the breath held. Barotrauma of the lungs may be occasionally observed in anesthesiological practice as well. The paper discusses the etiopathogenesis, clinical manifestations and treatment of the complaint. The author has observed and described three cases of barotrauma of the lungs, one of which ended in death. It is emphasized that effective treatment of pulmonary barotrauma is feasible only when a barochamber is available, large enough to accommodate the performance of resuscitation and, if necessary, surgical interventions. GRA

**N86-27915#** School of Aerospace Medicine, Brooks AFB, Tex.  
**SOFT CONTACT LENS WEAR DURING +G(Z) ACCELERATION**  
**Final Report, Oct. 1982 - Jun. 1985**  
W. J. FLYNN, M. G. BLOCK, W. F. PROVINCES, T. J. TREDICI, and R. D. KULLMAN Dec. 1985 23 p  
(AD-A165013; USAFSAM-TR-85-84) Avail: NTIS HC A02/MF A01 CSCL 17H

The effects of +G sub z on soft contact lens wear are reported here. Human centrifuge rides up to +8 G sub z were accomplished on 11 subjects. Six myopic subjects were tested with low-, medium-, and high-water-content spherical soft lenses. Two astigmatic subjects were tested with various designs of toric soft lenses. In addition, the contact lens subjects were tested with spectacles for comparison. Three emmetropic subjects served as controls. Video photography was used to monitor lens position during the centrifuge rides; and visual acuity was checked at +1, +2, +4, +6 and +8 G sub z with a reduced Snellen eye chart. Each lens type and control run was evaluated in straight-ahead, lateral, and vertical gaze. No significant decentration was noted for any of the lens types tested up to the maximum level of +8 G sub z. Visual acuity was reduced at the higher +G sub z levels for contact lenses, and spectacle trials, and with the emmetropic controls--all to similar levels. Contact lens did not produce any corneal insult due to the +G sub z exposure. Author (GRA)

**N86-27916#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**INFLUENCE OF ERYTHROCYTHEMIA ON BLOOD VOLUME AND THERMOREGULATION DURING EXERCISE-HEAT STRESS**

M. N. SAWKA, R. C. DENNIS, R. R. GONZALEZ, A. J. YOUNG, and S. R. MUZA 1986 31 p  
(AD-A165014; USARIEM-M-13/86) Avail: NTIS HC A03/MF A01 CSCL 06S

We studied the effects of autologous erythrocyte infusion on blood volume and thermoregulation during exercise in the heat. Using a double blind design, nine unacclimated male subjects were infused with either 700 ml of a NaCl glucose-phosphate solution containing a approx. 60% hematocrit (n=6, reinfusion) or 700 ml of this solution only (n=3, saline). A heat stress test (HST) was attempted approximately 2 wk pre-and 48 h post-infusion during the late spring months. After 30 min of rest in a 20 C antechamber, the HST consisted of a 120-min exposure (two repeats of 15-min rest and 45-min treadmill walking) in a hot (35C, 45% rh) environment while euhydrated. Red cell volume (RCV, 51 CR) and plasma volume (PV, 125I) were measured 24-h before each HST, and maximal oxygen uptake (VO<sub>2</sub> max) was measured 24-h after each HST. Generally, no significant effects were found for the saline group. For the reinfusion group, RCV

(11%, P<0.01) and VO<sub>2</sub> max (11%, P<0.05) increased after infusion, and the following observations were made: (1) the increased RCV was associated with a reduction in PV to maintain the same blood volume as during the preinfusion measurements; (2) erythrocythemia reduced total circulating protein, but did not alter F-cell ratio, plasma osmolality, plasma protein content, or plasma lactate at rest or during exercise-heat stress; (3) erythrocythemia did not change the volume of fluid entering the intravascular space from rest to exercise-heat stress. GRA

**N86-27917#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**URINARY AND HEMATOLOGICAL INDICES OF HYPOHYDRATION**

R. P. FRANCESCONI, R. W. HUBBARD, P. C. SZLYK, D. SCHNAKENBERG, and D. CARLSON 1986 22 p  
(AD-A165015; USARIEM-M-15/86) Avail: NTIS HC A02/MF A01 CSCL 06S

As part of a large scale field feeding system test we had the unique opportunity to collect and study hundreds of overnight urine aliquots which were obtained immediately prior to a fasting blood sample on days 1, 20, and 44 of the field test. To evaluate the hydration status of test subjects and criteria of hypohydration, urine aliquots were categorized by specific gravity > or = 1.03 (n=124) or < 1.03 (n=540). Creatinine levels were elevated (p<.001) in the concentrated urine samples, but a decreased trend in Na(+)/K(+) ratios in these samples failed to achieve statistical significance (p=0.1). However, when individuals with high specific gravity urine were further subclassified by a criterion of weight loss > 3% from original body weight, then creatinine concentrations were elevated (p=.05) while Na(+)/K(+) ratios were decreased (p=.05) when compared with levels in subjects also with high specific gravity but weight loss < 3%. Serum urea nitrogen/creatinine ratios were significantly increased (days 1 and 44, p=.02) in test subjects whose urine samples exceeded 1.03 in specific gravity. The results of this study indicated that prodromal hypohydration, indicated by concomitant elevations in urinary specific gravity and creatinine, was not reflected in the common indices of circulatory hypohydration- hematocrit and osmolality. Alternatively, urea nitrogen/creatinine ratio may be a sensitive circulatory index of imminent hypohydration. GRA

**N86-27918#** Health Effects Research Lab., Research Triangle Park, N. C.

**FACTORS INFLUENCING CARBOXYHEMOGLOBIN STABILITY**  
**Final Report, 1983 - 1984**

G. M. GOLDSTEIN, L. RAGGIO, and D. HOUSE 26 Mar. 1985 39 p Prepared in cooperation with Rockwell International Corp., Chapel Hill, N.C.  
(AD-A165032; TR-1811) Avail: NTIS HC A03/MF A01 CSCL 06A

Carbon monoxide (CO) is a byproduct of the incomplete combustion of hydrocarbons. Because of its high affinity for oxygen binding sites on hemoglobin and displacing oxygen, the presence of CO in the atmosphere has been shown to produce adverse health effects, affecting the cardiovascular system as well as causing behavioral changes. These changes have been reported at concentrations of carboxyhemoglobin (COHb) in the range of 4 to 6%. The Department of Defense (DOD) is concerned about the production of CO in fixed and mobile weapon systems and the relationship between behavior and health effects in military personnel associated with this exposure. The source of CO in a combat situation is exhaust gases from motorized vehicles and propellant gases from weapon systems. Studies were conducted to determine the stability of carboxyhemoglobin (COHb) in evacuated blood containers using the IL-282 co-oximeter as the measurement instrument. This study has shown that COHb levels decrease by 5 to 10% of the original value after three days of storage and remain stable for 14 days at 4 C or 21 C in vacutainers containing heparin or EDTA. The storage temperature, 4 C or 21 C had no appreciable effect on COHb levels. Blood samples that contained the anticoagulant heparin had higher initial values of COHb than samples with EDTA. In this study ambient room light



levels did not affect the measured levels of COHb at 4C for 5 days. GRA

**N86-27919#** Texas Univ., Arlington. Dept. of Psychology.  
**EFFECTS OF ATROPINE SULFATE ON AIRCREW PERFORMANCE Final Report, Mar. 1983 - Apr. 1985**  
 M. L. LOBB, J. D. PHILLIPS, JR., and A. S. WINTER Dec. 1985  
 16 p  
 (Contract F33615-83-K-0611)  
 (AD-A165063; USAFSAM-TR-85-48) Avail: NTIS HC A02/MF  
 A01 CSCL 06O

The human/animal literature on performance effects of atropine sulfate is reviewed and extrapolated to aircrew requirements. Subjective reports and physiological dose-response curves are used to estimate effective dosage levels for performance; ED50 is the dose at which 50% of an aircrew experiences a detectable performance change. Based on this review and extrapolation, the ED40 level for atropine sulfate is 2 mg IM/person for performance effects on near vision, alertness, equilibrium, response-force discrimination, and enunciation: the ED5 level is estimated at 1.35 mg IM/person. Although the published literature on simultaneously administered acetylcholinesterase inhibitors and blockers is insufficient to warrant even a tentative conclusion, the initial results suggest a combined mode of action in the visual system; if confirmed, such action would limit the use of atropine to counteract chemical-warfare performance decrements. Thus although atropine may be lifesaving, it does not prevent aircrew performance losses due to chemical-warfare agents and may impose additional decrements. GRA

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### BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**A86-37276**  
**THE STRESS SYNDROME**  
 F. SANDERS and J. ETHELL Cockpit (ISSN 0742-1508), Jan.-Mar. 1986, p. 5-11.

The effects of extended acute stress on the performance of pilots are analyzed. The symptoms of stress which include reduced cognitive capability, failure to perceive passage of time, personality change, tunnel vision, detachment from the situation, and uncontrolled shaking are described. The influence of stress-induced endorphin on the synaptic gap function of the brain is studied. Methods of relieving or 'preburning' stress are examined. The need for self-monitoring of stress is discussed. I.F.

**A86-38984**  
**DESIGNING THE CONDITIONS OF LIFE AND WORK OF COSMONAUTS (2ND REVISED AND ENLARGED EDITION)**  
**[PROEKTIROVANIE USLOVII ZHIZNI I RABOTY KOSMONAVTOV /2ND REVISED AND ENLARGED EDITION/]**  
 N. N. GUROVSKII, F. P. KOSMOLINSKII, and L. N. MELNIKOV  
 Moscow, Izdatel'stvo Mashinostroenie, 1985, 152 p. In Russian. refs

The factors that influence cosmonauts in space are analyzed. The basic spacecraft design and work of the cosmonauts are described. The effects of cabin conditions on crew life during long space flights are investigated. The organization of the crews' cabin and methods of increasing the cosmonauts work efficiency are discussed. Psychological and physiological stresses due to space flight are studied. I.F.

**N86-26826** Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.

**DRIVING PERFORMANCE THE DAY AFTER USE OF LOPRAZOLAM, FLUNITRAZEPAM AND PLACEBO**  
 E. R. VOLKERTS, G. DEVRIES, T. MEIJER, and J. F. OHANLON  
 Jun. 1984 66 p Revised Sponsored in part by Netherlands' Ministerie van Onderwijs en Wetenschappen and Roussel-UCLAF, France  
 (VK-83-04; ISBN-90-6807-005-3; B8561714; ISSN-0167-8590; ESA-86-96948) Avail: Issuing Activity

In order to determine if loprazolam, a mild hypnotic drug, has residual effects on driving performance and if a dose-effect relationship exists, 16 female subjects performed a driving test in 1 of 4 conditions. Loprazolam was administered in doses of 1 mg and 2 mg in conditions 1 and 2; flunitrazepam in a dose of 2 mg was administered as the active drug control in the third condition; and a placebo was given in the fourth condition. Nightly doses of loprazolam 1 mg and flunitrazepam 2 mg can slightly degrade driving performance the following day, but the degree of impairment seems insufficient to preclude the drugs' use by drivers. Nightly doses of loprazolam 2 mg can seriously degrade driving performance for up to 17 hours and this dose is not recommended for use by drivers. ESA

**N86-26827** Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.

**THE EFFECTS OF THE ANTIDEPRESSANTS OXAPROTIline, MIANSERIN, AMITRYPTILINE AND DOXEPIN UPON ACTUAL DRIVING PERFORMANCE**  
 J. W. LOUWERENS, K. A. BROOKHUIS, and J. F. OHANLON  
 Jun. 1984 77 p Sponsored in part by Netherlands' Ministerie van Onderwijs en Wetenschapsbeleid and Ciba-Geigy AG, Basle, Switzerland  
 (VK-83-05; ISBN-90-6807-006-1; B8561711; ISSN-0167-8590; ESA-86-96949) Avail: Issuing Activity

The effects of antidepressants and a placebo were compared using a driving test. Five treatments were administered to 20 healthy young male volunteers on separate days, spaced at least 5 days apart. These were: oxaprotiline, amitryptiline and doxepin 75 mg (25 mg tid); mianserin 30 mg (10 mg tid); and placebo. Doses of each drug and placebo were administered 10, 6, and 2 hours before tests. Oxaprotiline is generally without adverse acute effects upon driving performance, but may produce either impairment or improvement in particular individuals. Amitryptiline, mianserin and doxepin, in that order, have adverse acute effects on driving performance. Individuals suffering impairment as a consequence of antidepressants' acute effects can recognize the implications for driving safety and cease driving, while others cannot, and continue driving with progressively deteriorating performance until their safety is seriously compromised. ESA

**N86-26828#** Yale Univ., New Haven, Conn. Dept. of Psychology.

**COMPONENTS OF VERBAL INTELLIGENCE Final Report, 1 Oct. 1982 - 30 Sep. 1985**  
 R. J. STERNBERG 30 Dec. 1985 47 p  
 (Contract N00014-83-K-0013)  
 (AD-A163359) Avail: NTIS HC A03/MF A01 CSCL 05J

This project develops and tests a theory of the components of verbal intelligence. Alternative theoretical frameworks for understanding verbal intelligence are reviewed, and then a componential theory of verbal comprehension is proposed. The theory specifies the information-processing components, context cues, and mediating variables underlying acquisition of word meanings from context. A number of experiments testing and supporting the theory are described, including experiments involving both internal and external context. Instructional experiments are also described, and it is concluded that the theory is well supported by the data, and moreover, that it can serve as a useful basis for training people in how to learn meanings of words from context. The theory is extended to novel kinds of concepts as well, and it is shown that the learning of novel concepts involves an interaction between linguistic and conceptual unfamiliarity. In a series of

experiments on causal inference involving verbal versus symbolic-abstract materials, it is shown that although a core of logical operations is applied to both verbal and abstract materials, special processes are involved when people reason about meaningful verbal materials. GRA

**N86-26829#** Xerox Palo Alto Research Center, Calif.  
**ACQUIRING PROCEDURAL SKILLS FROM LESSON SEQUENCES** Final Report, 1 Jan. 1982 - 15 Jun. 1985

K. A. VANLEHN 13 Aug. 1985 53 p  
 (Contract N00014-82-C-0067)  
 (AD-A164580; ISL-9) Avail: NTIS HC A04/MF A01 CSDL 05J

This report provides an informal overview of a theory that describes how people learn certain procedural skills, such as arithmetic and algebra, from multi-lesson curricula. The central hypothesis is that students and teachers obey conventions that cause the goal hierarchy of the acquired procedure to be a particular structural function of the sequential ordering of lessons. This learning theory is an extension of *Repair Theory*, which describes how people mix interpretation and a certain type of meta-level problem solving as they try to solve practice problems. The learning theory has been embedded in a program that generates detailed predictions about the products of published curricula. The predictions have been tested against data from several thousand mathematics students. GRA

**N86-26830#** Naval Postgraduate School, Monterey, Calif.  
**CHANGES IN NAVAL AVIATION BASIC INSTRUMENT FLIGHT TRAINING: AN ANALYSIS** M.S. Thesis

J. Y. WALLACE, III Dec. 1985 108 p  
 (AD-A164738) Avail: NTIS HC A06/MF A01 CSDL 05I

This thesis evaluates a modification to the Navy's Basic Instrument flight instruction, the performance of two groups of student aviators was compared. The modifications consisted of a lecture concentrating on the fundamentals of attitude instrument flight. One group of 100 students received the new training while a control group of 100 students did not. Analysis of the flight grades of the two groups revealed no significant difference in their performance. Based on the results of this research it was concluded that the modified basic instrument training did not improve the performance of student naval aviators. However, the modified lecture and training did improve the student's understanding of basic instrument fundamentals. The study recommended that the modified lecture should be continued as part of the syllabus because the benefits from affording the student aviators with additional training exceed the small costs involved. ign, Flight skills acquisition. GRA

**N86-26831#** Vanderbilt Univ., Nashville, Tenn. Dept. of Psychology.

**INTERACTION OF IMAGE CHARACTERISTICS OF STEREOSCOPIC FORMS DURING DEPTH PERCEPTION** Final Report, 1 Oct. 1980 - 30 Jun. 1984

R. FOX Aug. 1985 35 p refs  
 (Contract N00014-81-C-0001)  
 (AD-A164895; N14-0001-85C-0001) Avail: NTIS HC A03/MF A01 CSDL 06P

The primary objective of this research program was to determine the degree of congruence between the apparent or perceived depth position of a stereoscopic form and the position predictable from the physical conditions of stimulation. This topic, which bears directly on the veridicality or validity of depth information presented in a stereoscopic or 3-d display, has been investigated previously under restricted laboratory conditions that yield results of limited generality. For that reason, the present inquiry was pursued under naturalistic conditions similar to those that would obtain during the routine operation of visual displays. To gain insights into potential interactions between depth position (X-axis) and stimulus configuration (X- and Y-axes), stereoscopic forms were created from dynamic random element stereograms continuously generated electronically. This approach precluded the occurrence of non-stereoscopic cues that can arise in conventional depth displays. GRA

**N86-26832#** School of Aerospace Medicine, Brooks AFB, Tex.  
**THE HEALTHY MOTIVATION TO FLY: NO PSYCHIATRIC DIAGNOSIS** Final Report, 1 Jul. - 31 Aug. 1985

R. R. ADAMS and D. R. JONES Nov. 1985 15 p refs  
 (AD-A164944; USAFSAM-TR-85-77) Avail: NTIS HC A02/MF A01 CSDL 05J

Aircrew mission effectiveness may uniquely be influenced by subtle psychological factors, not ordinarily brought to the attention of psychiatrists. Pilots tend to be bright, articulate, and anxious to resume their aviation duties when grounded. However, these patients are usually well defended, and rarely psychologically attuned or introspective. Greater insight into what constitutes the normal, healthy motivation to fly will help those who make judgements regarding the return of grounded aviators to flying duty. A review of associated birth order, personality theory, industrial and business psychology, aerospace, and psychoanalytic literature is presented. Highlighted are the difficulties inherent in examining the motivation of a healthy, well-defended population. Our conclusion: an examiner's countertransference feelings are the best available tool for measurement of healthy motivation. GRA

**N86-26833#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

**THE ROLE OF ELABORATIONS IN INSTRUCTIONAL TEXTS: LEARNING TO USE THE APPROPRIATE PROCEDURE AT THE APPROPRIATE TIME** Technical Report, Jan. - Oct. 1985

D. H. CHARNEY 14 Feb. 1986 85 p  
 (Contract N00014-84-K-0063; NR PROJ. RR0-4206)  
 (AD-A165211; TR-86-2-ONR) Avail: NTIS HC A05/MF A01 CSDL 05I

This research investigates the kinds of information that should be included in instructional texts that teach skills (such as manuals or textbooks). It focuses on an important subcomponent of skill learning: choosing the right procedure at the right time. Learning to choose the right procedure is difficult in skills such as using a computer because the connection between real-world goals and the generic procedures described in a manual is often obscure. Furthermore, when several procedures have similar functions, it is difficult to tell which one is best for a particular situation. In order to facilitate the decision process, instructional tests may include advice about when to use particular procedures and may illustrate the advice with examples. The research reported here investigated the effect of various forms of advice on learners' strategies for choosing a procedure. Subjects read one of four versions of a manual for a computer game called *Box-World*. Three versions contained advice about when to use particular game procedures; the advice was either stated as a simple verbal rule or elaborated with one of two types of examples. The fourth version contained no advice. Subjects then performed three tasks: a recall task, a recognition task (i.e., discriminating between correct and incorrect applications of the advice), and a decision task (i.e., solving problems for which the advice was relevant). Author (GRA)

**N86-26834#** Groningen Rijksuniversiteit (Netherlands). Traffic Research Center.

**FLURAZEPAM HCL'S RESIDUAL (HANGOVER) EFFECTS UPON ACTUAL DRIVING PERFORMANCE**

J. F. OHANLON, E. R. VOLKERTS, G. DEVRIES, A. VANARKEL, M. WIETHOFF, and T. MEIJER Nov. 1984 58 p Revised  
 Sponsored in part by Netherlands' Ministerie van Onderwijs en Wetenschapsbeleid and F. Hoffmann-La Roche and Co., Ltd., Basle, Switzerland  
 (VK-83-02; B8462753; ISBN-90-353-0030-0; ISSN-0167-8590; ESA-86-96947) Avail: NTIS HC A04/MF A01

The effects on driver performance of taking a hypnotic drug (flurazepam HCL) were assessed on 40 female subjects aged between 25 and 40. An acute experiment wherein a larger group's performance was assessed following 2 nights of drug or placebo treatment; and a subchronic experiment wherein a smaller group's performance was assessed, before, during and after 8 consecutive nights of treatment with flurazepam 30 mg were conducted. Flurazepam doses of 15 mg and 30 mg were administered in different treatment conditions of the acute experiment. Secobarbital



200 mg was administered in another condition as the active drug control, and a placebo was administered in the final condition. Flurazepam 30 mg impairs driving performance for at least 17 hours following drug intake. Flurazepam's residual effect is dose-dependent. Serious impairment can occur. ESA

**N86-26835#** National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

**A MODEL AND EXPERIMENTAL ANALYSIS OF PILOT DECISION MAKING BEHAVIOR FOR VARIOUS AUTOMATIC APPROACH CONDITIONS**

R. C. VANDEGRAAF and P. H. WEWERINKE 5 Apr. 1984 48 p  
(Contract NIVR-1857; BMFT-0101-ZA/WF/WRD-174/4)  
(NLR-TR-84037-U; ESA-86-96980) Avail: NTIS HC A03/MF A01

Four experienced airline pilots monitored stabilized automatic approaches in a flight simulator, to assess a failure detection model. The tasks comprised the detection of excessive longitudinal and lateral windshears, and of system failures on the glideslope and localizer indicators. Two failure probability conditions were included to investigate the effect of the subject's failure expectancy on the detection performance. Good agreement between the model predictions and the experimental results of two subjects is obtained. The failure detection times of the two other subjects are larger, especially for the windshear conditions, due to a more conservative detection strategy. Results indicate the usefulness of an analytical capability for investigating relative effects of aircraft design parameters, such as display integrity, configuration, and format on failure detection performance. ESA

**N86-27881#** Joint Publications Research Service, Arlington, Va. **PSYCHOEMOTIONAL PILOT STRESS PRIOR TO EJECTION AND ITS ROLE IN APPROPRIATE PERFORMANCE**

A. P. KOZLOVSKIY and A. F. KOVALENKO *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 19-24 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 16-19 Avail: NTIS HC A08

It was demonstrated that with respect to the psychoemotional state real and simulated catapulting events were similar. The time-course variations in the latent period of the motor reaction were obtained. The time interval between the command Go and the catapulting event was found to increase significantly in relation to the latent period. This was correlated with the level of psychoemotional strain. Author

**N86-27883#** Joint Publications Research Service, Arlington, Va. **EFFECT OF RHYTHMIC PHOTIC INTERFERENCE ON WORKING ELECTROENCEPHALOGRAPHY AND EFFICIENCY OF HUMAN MOVEMENTS**

Y. T. PETRENKO and L. A. YERMUKHAMETOVA *In its* USSR Report: Space Biology and Aerospace Medicine, No. 1, January - February 1986 (JPRS-USB-86-003) p 29-33 17 Apr. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 1, Jan. Feb. 1986 p 22-25 Avail: NTIS HC A08

The effect of rhythmic light flashes on the space-time pattern of brain biopotentials during motor functions and biomechanical efficiency of man's actions was investigated. As the motor model, the ability to maintain equilibrium when standing on the toes of one foot was used. Electroencephalography (EEG) from 12 neocortical areas and oscillations of the body mass center (stabilography) were recorded in 20 men who performed the exercise under normal conditions and during light flashes of 12 Hz. The resultant EEG and stabilograms were exposed to correlations-spectral and coherent analysis with the aid of an EC-1035 computer. Light flashes induced a change in the EEG peaks and flicker fusion frequency, a significant increase of the density of biopotentials corresponding to the light stimulation frequency, and a redistribution of the number of high intercentral

correlations between neocortical motor centers. When the light flashes were presented, 75 to 85% of the test subjects showed a 0.19 to 0.26 increase in the biopotential coherence of the premotor, motor and sensomotor areas. They also exhibited a significant decrease in the body stability and an increase in the stabilographic amplitude and frequency. It is suggested that the decline of biomechanical efficiency is associated with the disorders of the space-time integration between neocortical centers involved in the motor control system that are responsible for the execution of motor acts. Author

**N86-27920\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**ANALYTICAL TECHNIQUES OF PILOT SCANNING BEHAVIOR AND THEIR APPLICATION**

R. L. HARRIS, SR., B. J. GLOVER (PRC Kentron, Inc., Hampton, Va.), and A. A. SPADY, JR. Jul. 1986 46 p refs  
(NASA-TP-2525; L-15995; NAS 1.60:2525) Avail: NTIS HC A03/MF A01 CSCL 051

The state of the art of oculometric data analysis techniques and their applications in certain research areas such as pilot workload, information transfer provided by various display formats, crew role in automated systems, and pilot training are documented. These analytical techniques produce the following data: real-time viewing of the pilot's scanning behavior, average dwell times, dwell percentages, instrument transition paths, dwell histograms, and entropy rate measures. These types of data are discussed, and overviews of the experimental setup, data analysis techniques, and software are presented. A glossary of terms frequently used in pilot scanning behavior and a bibliography of reports on related research sponsored by NASA Langley Research Center are also presented. Author

**N86-27921#** School of Aerospace Medicine, Brooks AFB, Tex. **US AIR FORCE COMBAT PSYCHIATRY Final Report, Jan. 1979 - Jun. 1985**

D. R. JONES Jan. 1986 44 p  
(AD-A165011; USAFSAM-TR-85-83) Avail: NTIS HC A03/MF A01 CSCL 05J

The U.S. Air Force faces the distinct possibility that its bases may be vulnerable to enemy attack. Combat fatigue may thus affect nonfliers, whereas in past conflicts fliers have been the ones affected. This report reviews the literature on the effects of combat: first on fliers, then on nonfliers. The report suggests that flight surgeons use 2 main agents of therapy, rest and the force of their personality, to delay or prevent combat fatigue in fliers. The report also discusses the relevant signs and symptoms, both in fliers and in nonfliers, and ends with a presentation of the principles of Brevity, Immediacy, Centrality, Expectancy, Proximity, and Similitude in dealing with combat fatigue in nonfliers. GRA

**N86-27922#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

**INITIAL SKILL LEARNING: AN ANALYSIS OF HOW ELABORATIONS FACILITATE THE THREE COMPONENTS Technical Report, Oct. 1984 - Feb. 1986**

D. H. CHARNEY and L. M. REDER 14 Feb. 1986 57 p  
(Contract N00014-84-K-0063)  
(AD-A165137; TR-86-1-ONR) Avail: NTIS HC A04/MF A01 CSCL 05J

This paper is concerned with the issue of how verbal instructions influence skill learning. In particular, our goal is to outline the components of initial cognitive skill acquisition and analyze what features of elaborations in the instructional materials can facilitate each component. We identify three basic components of skill learning: learning novel concepts and the functionality of novel concepts and procedures; learning how to execute the procedures; and learning the conditions under which the procedures can and should be applied. Each of these components can be learned independently and each component can be a bottleneck to acquiring a skill. Situation examples are the most useful type of elaboration for skill learning because each example can contribute to learning in all three components. On the other hand, while

analogies can be constructed to illustrate each component, they are more likely to help people learn the functionality of a procedure than how to execute it or when to select it. However, since learners tend to rely on examples as models, it is very important to choose examples with great care and to provide enough examples to illustrate the range of application of a rule or procedure. Otherwise, learners may interpret a rule incorrectly or make spurious assumptions about the conditions under which it applies. GRA

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## MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

## A86-38510

### VALIDATION OF SOM-LA OCCUPANT RESPONSE

D. H. LAANANEN (Arizona State University, Tempe) IN: Crash dynamics of general aviation aircraft; Proceedings of the General Aviation Aircraft Meeting and Exposition, Wichita, KS, April 16-19, 1985. Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 1-12. refs

(Contract DOT-FA03-84-P-01649)

(SAE PAPER 850850)

Program SOM-LA (Seat/Occupant Model - Light Aircraft) has been developed for use in evaluating the crashworthiness of aircraft seats and restraint systems. It combines a three-dimensional dynamic model of the human body with a finite element model of the seat structure. The seat analysis has the capability to model large displacements, nonlinear material behavior, local buckling, and various internal releases for beam elements. Simulation results are compared with test data for several impact orientations and for two restraint system configurations, including the use of a lap belt alone. Author

## A86-38512

### REGIONAL TOLERANCE TO IMPACT ACCELERATION

A. I. KING (Wayne State University, Detroit, MI) IN: Crash dynamics of general aviation aircraft; Proceedings of the General Aviation Aircraft Meeting and Exposition, Wichita, KS, April 16-19, 1985. Warrendale, PA, Society of Automotive Engineers, Inc., 1985, p. 29-37. refs

(SAE PAPER 850852)

Human tolerance data have been acquired gradually over the past 25 years and are available for several body regions. There is now sufficient information to design restraint systems which can prevent serious injuries to the user and which have low injury-causing potential. This paper reviews recent research on injury mechanisms and injury tolerance. Most of the research was aimed at solving problems in automotive safety systems. Specific tolerance data for the following body regions are presented: head, chest, spine and lower extremities. Author

## A86-38988

### COSMONAUT TRAINING [PROFESSIONAL'NAIA PODGOTOVKA KOSMONAVTOV]

V. N. KUBASOV, V. A. TARAN, and S. N. MAKSIMOV Moscow, Izdatel'stvo Mashinostroenie, 1985, 288 p. In Russian. refs

Basic data concerning the methods and facilities for the scientific and technical training of cosmonauts are examined. The development and performance of ergatic space systems and the functions of the operator-cosmonaut in the system are studied. The requirements for the scientific and technical training of cosmonauts are described, and the procedures for the training are evaluated. The work efficiency of the operator-cosmonaut and training facilities is analyzed. I.F.

N86-26318# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

### COCKPIT AUTOMATION REQUIREMENTS DERIVED FROM MISSION FUNCTIONS DATA

B. FAULKNER, R. SEIFERT, and K. D. RICHTER IN AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations 7 p Oct. 1985 refs

Avail: NTIS HC A07/MF A01

Program activities directed towards the development of a system engineering concept for the design of the man-machine interface are summarized. The problem was approached from an operational and human task point of view. The first phase included the development of: (1) a mission task list for selected mission and weapon systems; (2) a method for rating the relative importance of each of the tasks related (a) to the frequency of occurrence, (b) to mission effectiveness, and (c) to flight safety; (3) criteria and/or categories for automation at the man-machine interface, against which the individual mission tasks could be rated; and (4) a method for rating the mission tasks in relation to the automation categories derived. Author

N86-26319# Ferranti Defence Systems Ltd., Edinburgh (Scotland).

### AUTOMATION AND PILOT INTERACTIONS IN NIGHT OR ALL-WEATHER TACTICAL OPERATIONS

W. H. MCKINLAY IN AGARD Guidance-Control-Navigation Automation for Night All-Weather Tactical Operations 10 p Oct. 1985

Avail: NTIS HC A07/MF A01

Some of the areas in which automation could be used to reduce pilot workload when operating at night or in low visibility are examined. It is shown that in navigation the pilot's task extends from the planning stage before take off to the point at which tactical decisions are taken in the air. The role of the mission planning system and the features of a system developed for this purpose are covered. The nature of the man-machine interface including its required features and the impact of the latter on the core avionic system including navigation and the MMI are addressed. Author

N86-26805# German Army Aviation School, Bueckeburg (West Germany).

### OPERATIONAL EXPERIENCES WITH NIGHT VISION GOGGLES IN HELICOPTER LOW-LEVEL FLIGHT AT NIGHT

H. HAIDN IN AGARD Visual Protection and Enhancement 8p Dec. 1985 refs

Avail: NTIS HC A11/MF A01

The operational marginal conditions are described with regard to the threat analysis in the Central European theater. This is supplemented by a presentation of the technological and physical aspects of the available visual sensors, such as helmet mounted night vision goggles, low light level television, and forward looking infrared and their employment as pilotage aids within the helicopter cockpit. Also, a description is given of the work capabilities and limitations inherent with the employment of electro-optical vision aids. This involves a comparison of the visual capabilities of the unaided eye during low level flight with Moon illumination at night, conditions during reduced light levels, and viewing the same scene with electro-optical sensors. The requirement for glare protection within the cockpit is discussed and different solutions are represented. An exceptional and difficult problem to solve is currently presented by positive position fixing under the given circumstances. Aids and procedures to improve navigation were devised and are now successfully in use. Finally, the results of interviews with helicopter pilots, who have long term experience with the use of helmet mounted night vision goggles are discussed. Author

**N86-26807#** Naval Air Development Center, Warminster, Pa.  
**VISUAL AND SPECTORADIOMETRIC PERFORMANCE CRITERIA FOR NIGHT VISION GOGGLES (NVG) COMPATIBLE AIRCRAFT INTERIOR LIGHTING**

W. A. BREITMAIER and F. REETZ, III /In AGARD Visual Protection and Enhancement 11 p Dec. 1985 refs  
 Avail: NTIS HC A11/MF A01

A draft military specification for NVG-compatible aircraft interior lighting was developed. The specification is based on the utilization of a specific type of NVG, the AN/AVS-6 Aviators Night Vision Imaging System (ANVIS). The performance requirements and testing methodology established in the specification and the rationale for developing these requirements are described. The performance requirements are affected by three factors: luminance, chromaticity, and ANVIS compatibility. Luminance requirements do not change drastically from the requirements that presently exist for interior lighting. However, the chromaticity requirements of green for primary and secondary lighting, and yellow for both master caution and warning indicators are different from those that presently exist. The reason for this change is that any lighting with a significant amount of red energy cannot be used in a cockpit that is required to be ANVIS compatible. The implications for this new color design for cockpit lighting are discussed together with the rationale for the chromaticity coordinates and limits chosen. ANVIS compatibility is defined in terms of the spectral sensitivity of the ANVIS and the combination of spectral radiance of the cockpit lighting and the outside world night radiance. Quantitative testing methodology for determining ANVIS compatibility of cockpit lighting is also discussed. A thorough description of all analytic and laboratory studies performed in support of this specification development is presented. Author

**N86-26813#** Letterman Army Inst. of Research, San Francisco, Calif.

**COMPUTER VISUAL SIMULATION OF CONTRAST SENSITIVITY DEFICITS INDUCED BY LASER AND CHEMICAL ANTIDOTE EXPOSURE**

H. ZWICK, D. MONROE, and L. SHERMAN /In AGARD Visual Protection and Enhancement 4 p Dec. 1985  
 Avail: NTIS HC A11/MF A01

Training in some complex combat related tasks may produce a degree of transient visual impairment which may simulate what could be expected in combat. A method is presented for simulating visual impairment produced by potential combat conditions. The use of a computer to both digitize and store as well as produce the simulated image has provided an ideal tool for research. The degree of realism provided by such simulation offers suggestions for development of more realistic training techniques. Author

**N86-26816#** National Aerospace Medical Centre, Soesterberg (Netherlands).

**DYNAMIC BEHAVIOUR OF SPHERICAL AND ASPHERICAL CONTACT LENSES EXPOSED TO +GZ-ACCELERATION FORCES**

H. PUNT, A. C. H. VANDENHEUVEL, H. H. VANDENBIGGELAAR (Royal Netherlands Air Force, The Hague.), G. J. HOEKSTRA, and A. J. P. ROUWEN (Militair Hospitaal Dr. A. Mathijssen, Utrecht (Netherlands).) /In AGARD Visual Protection and Enhancement 5 p Dec. 1985  
 Avail: NTIS HC A11/MF A01

A study was made of the behavior of two types of hard contact lenses fitted to a young myopic pilot and exposed to +Gz-acceleration forces. The degree of dislocation of the hard lenses was studied as was the pathological phenomena of the cornea under increasing +Gz-forces. The two types of the evaluated contact lenses are a conventional spherical polymethylmethacrylate (PMMA) lens and an aspherical gas-permeable lens. In a human centrifuge a test person was exposed to +Gz-forces increasing from +1 to +9 Gz. In the gondola a videotelecamara was focussed at the head of the test person during the total test session. It could be concluded that the aspherical gas-permeable contact lenses maintained an optimal concentration under all circumstances. The conventional hard

contact lenses with a spherical base curve and a smaller diameter showed downward decentration under increasing +Gz-loads from +6 Gz to a peak value of 8.6 Gz. However, the dislocation never caused the contact lens to leave the cornea. The results are discussed in relation to practical consequences for pilot flying high performance aircraft. Author

**N86-26825#** British Aerospace Public Ltd. Co., Lancashire (England). Cockpit Specialist Group.

**HUMAN FACTORS: THE CINDERELLA DISCIPLINE IN COCKPIT INTERFACE DESIGN**

K. W. MARTIN and J. LAYCOCK (Royal Aircraft Establishment, Farnborough, England) /In AGARD Visual Protection and Enhancement 10 p Dec. 1985  
 Avail: NTIS HC A11/MF A01

The present trend in military aircraft design towards compact cockpits, multifunction controls and displays, and integrated systems within more agile and smaller airframes, has resulted in a greater need for human factors involvement in the design of the man machine interface. The cockpit of the modern military aircraft is inevitably a compromise of conflicting design disciplines, and one in which human factors fails to achieve any long term influence because the discipline lacks the absolute argument necessary for survival in the industrial environment. If human factors are to establish the degree of influence the current levels of research justify, then a new approach is necessary. This approach must recognize the practical problems associated with the design and manufacture of the integrated weapons delivery system that future aircraft represent. One possible approach may be the generation of human factors design tools, for use by engineers, which incorporate human sensory emulations and provide outputs that can be integrated into the engineering discipline. Author

**N86-26836\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

**BASELINE EXPERIMENTS IN TELEOPERATOR CONTROL**

W. W. HANKINS, III and R. W. MIXON Jul. 1986 65 p  
 (NASA-TP-2547; L-15963; NAS 1.60:2547) Avail: NTIS HC A04/MF A01 CSCL 05H

Studies have been conducted at the NASA Langley Research Center (LaRC) to establish baseline human teleoperator interface data and to assess the influence of some of the interface parameters on human performance in teleoperation. As baseline data, the results will be used to assess future interface improvements resulting from this research in basic teleoperator human factors. In addition, the data have been used to validate LaRC's basic teleoperator hardware setup and to compare initial teleoperator study results. Four subjects controlled a modified industrial manipulator to perform a simple task involving both high and low precision. Two different schemes for controlling the manipulator were studied along with both direct and indirect viewing of the task. Performance of the task was measured as the length of time required to complete the task along with the number of errors made in the process. Analyses of variance were computed to determine the significance of the influences of each of the independent variables. Comparisons were also made between the LaRC data and data taken earlier by Grumman Aerospace Corp. at their facilities. Author

**N86-26837#** Cummings Solar Corp., Wilmington, Mass.

**DESIGN AND PRODUCTION OF DAMAGE-RESISTANT TRAY PACK CONTAINERS Final Report, 13 Apr. 1984 - 31 Jul. 1985**

R. D. CUMMINGS Jul. 1985 242 p refs  
 (Contract DAAK60-84-C-0011; DA PROJ. 1L1-62724-AH-99) (AD-A164595; NATICK-TR-86/008) Avail: NTIS HC A11/MF A01 CSCL 06H

The tray pack is a food container that serves the functions of food storage vessel; food heating vessel; and food serving vessel. The lid is drawn from 90-pound per base box (0.010-inch-thick) steel. The bottom or can is drawn from 90-pound per base box (0.010-inch-thick) steel. Both top and bottom have a polymeric inner linear and an outer organic coating. The cause of tray pack damage were determined to be: prestressing caused by vacuum

packing and underfilling; hydrodynamic forces induced by relative fluid motion within the tray pack at the moment of impact during dropping; and denting of the thin tray body material. The inability of the tray pack shipping container to withstand stacking loads was determined to be caused by poor tolerances of the shipping containers and denting of separation pads by the tray lid sealing seam. Test results show that damage can be prevented by avoiding vacuum packing, making the tray packs from 98-pound material, using a tray pack design employing reinforcing beads, using pads that nest within the sealing seam of the tray pack, and packing the tray packs so that the lids of the bottom two face down and top two face up. Test results also show that unit loads of tray packs can be stacked four high by using a properly dimensioned telescoping shipping container, the nesting pads and the two-up, two-down packing technique. GRA

**N86-26838#** Anthropology Research Project, Yellow Springs, Ohio.

**DEMOGRAPHIC AND ANTHROPOMETRIC ASSESSMENT OF US ARMY ANTHROPOMETRIC DATA BASE Interim Report, Sep. 1984 - Apr. 1985**

B. BRADTMILLER, J. RATNAPARKHI, and TEBBETTS, ILSE Aug. 1985 83 p  
(Contract DAAK60-84-C-0086; DA PROJ. 1L1-62723-AH-98)  
(AD-A164637; NATICK-TR-86/004) Avail: NTIS HC A05/MF A01 CSDL 05B

It has been nearly 20 years since the last anthropometric survey of Army males was conducted and about eight years since the last survey of Army females. The purpose of this report is to assess the extent to which the Army's existing anthropometric data base is representative of the current Army active duty force, both demographically and anthropometrically. The demographic variables of age, sex, and race are compared for the Army's existing anthropometric data base, the current active duty force, and the projected force of the 1990s. The changes in these variables occurring in the Army population are also contrasted with those occurring in the U.S. population at large. The anthropometric variables of stature and weight are compared for the existing data base and current active duty officers. Other anthropometric variables that are affected by race and age are also examined. Differences in anthropometric variables between the existing data base and the current active duty force are discussed in the context of secular trends in anthropometric measures from the U.S. population at large and other military populations. The implications of using the Army's existing anthropometric data base in the design and sizing of clothing and personal equipment are examined in light of the present and projected demographic composition of the Army active duty force. GRA

**N86-26839#** Materials Research Labs., Ascot Vale (Australia).  
**A LIGHTWEIGHT IMPERMEABLE SUIT FOR CHEMICAL PROTECTION IN WARM CONDITIONS: A PRELIMINARY LOOK AT THE CONCEPT**

R. I. TILLEY, J. M. STANDERWICK, G. J. LONG, and H. D. CRONE Aug. 1985 22 p refs  
(AD-A164687; MRL-R-972) Avail: NTIS HC A02/MF A01 CSDL 15B

A lightweight overgarment made of spun-bonded polyethylene was compared with the UK No. 1 Mk 3 NBC suit in terms of the heat burden imposed on wearers. The physiological responses of volunteers exercising in warm conditions were measured for both clothing ensembles and were found to be similar. These results suggested that the concept of a lightweight impermeable NBC suit for wear in jungle conditions was worthy of close investigation. Results also confirmed previous observations that soldiers wearing NBC clothing in warm and humid conditions could do little more than adopt a defensive position if they were not to become heat stress casualties. GRA

**N86-26840#** Pattern Analysis and Recognition Corp., McLean, Va.

**HUMAN FACTORS IN RULE-BASED SYSTEMS Final Report**

P. E. LEHNER, D. ZIRK, R. B. HALL, and L. ADELMAN 14 Oct. 1985 30 p refs  
(Contract N00014-83-C-0537)  
(AD-A165309; AD-E301922; PAR-85-109) Avail: NTIS HC A03/MF A01 CSDL 05H

This report summarizes several experiments investigating the impact of mental models and cognitive consistency on user/expert system interaction. Results indicate that user/expert system combined problem solving performance significantly improves if the user has a good mental model of expert system processes. Furthermore, cognitive consistency between the user and system problem solving procedures only degrades performance in situations where users do not have a good mental model. Some practical implications of this research is discussed.

Author (GRA)

**N86-26841#** Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

**SOLDIER-COMPUTER INTERFACE Final Report**

30 Nov. 1985 215 p  
(AD-A165326; TOP-1-1-059) Avail: NTIS HC A10/MF A01 CSDL 05E

The material in this TOP is intended to be used for the Human Factors Engineering (HFE) Evaluation of the Soldier-Computer Interface (SCI) of systems tested by TECOM. It encompasses procedures for an HFE Analysis and walk-through, mission simulation, and interview guide. Included are criteria in the form of checklists. GRA

**N86-26842#** School of Aerospace Medicine, Brooks AFB, Tex.  
**METHODOLOGY FOR INTEGRATION TESTING OF AIRCREW CLOTHING AND EQUIPMENT Final Report, Aug. 1982 - Dec. 1984**

P. H. R. GILL Dec. 1985 19 p refs  
(AD-A165328; USAFSAM-TR-84-19) Avail: NTIS HC A02/MF A01 CSDL 06Q

This report recommends a comprehensive range of tests for the integration and viability of an aircrew personal protective ensemble (PPE) or an item of PPE for use in an aircraft. It is emphasized that these tests are additional to any type test schedules for individual items of PPE. A test described in this report should be completed satisfactorily before the item or assembly is submitted for flight test evaluation. GRA

**N86-26843#** Pattern Analysis and Recognition Corp., McLean, Va.

**MENTAL MODELS AND PROBLEM SOLVING WITH A KNOWLEDGE-BASED EXPERT SYSTEM**

R. B. HALL Oct. 1985 28 p  
(Contract N00014-83-C-0537)  
(AD-A165398; PAR-85-108) Avail: NTIS HC A03/MF A01 CSDL 09B

Previous research in the area of user/expert system interaction has shown that the quality of problem solving with a general expert system (ES) is associated with mental model, a user's conceptual understanding of the basic principle of an ES's problem solving process. The current paper describes an experiment with MYCIN, a medical knowledge-based expert system, that lends additional support to the link between problem solving quality and mental model. GRA

## PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

**A86-38138****PREBIOTIC MATTER IN INTERSTELLAR MOLECULES**

R. D. BROWN (Monash University, Clayton, Australia) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 123-137. refs

The pathways by which aminoacids (AA) may have been constructed from various interstellar molecules are discussed, with attention focused on the detection of aminoacids in molecular clouds, and the gas-phase production of AA in these clouds. A search for the simplest AA, glycine, has thus far been unsuccessful. However, the possibility that chemically close relatives might be formed by gas-phase reactions in molecular clouds is considered. Again, consideration is restricted to glycine. Through crude calculations, it was discovered that a reasonable rate of glycinonitrile production is feasible and that fractional abundances could be as high as 10 to the -10th. Hence, glycinonitrile illustrates the possible pathway to proteins and primitive life. The question of interstellar molecular survival during the formation of planetary systems by the collapse of molecular clouds is addressed. It is suggested that heavy meteoritic falls would have brought this material to the earth's surface. It is also suggested that the chemical ancestry of life passes through interstellar AA nitriles rather than through the acids themselves. In addition, it seems feasible that this ancestry goes back to a parental molecular cloud, which may have, in effect, led to the evolution of life on other planets. K.K.

**A86-38139\*** Nobeyama Solar Radio Observatory (Japan).**RECENT OBSERVATIONS OF ORGANIC MOLECULES IN NEARBY COLD, DARK INTERSTELLAR CLOUDS**

H. SUZUKI, M. OHISHI, M. MORIMOTO, N. KAIFU (Nobeyama Radio Observatory, Nagano, Japan), P. FRIBERG (Massachusetts University; Five College Radio Astronomy Observatory, Amherst) et al. IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 139-144. refs (Contract NAGW-436; NSF AST-82-12252)

Recent investigations of the organic chemistry of relatively nearby cold, dark interstellar clouds are reported. Specifically, the presence of interstellar tricarbon monoxide (C<sub>3</sub>O) in Taurus Molecular Cloud 1 (TMC-1) is confirmed. The first detection in such regions of acetaldehyde (CH<sub>3</sub>CHO), the most complex oxygen-containing organic molecule yet found in dark clouds is reported, as well as the first astronomical detection of several molecular rotational transitions, including the J = 18-17 and 14-13 transitions of cyanodiacetylene (HC<sub>5</sub>N), the 1(01)-0(00) transition of acetaldehyde, and the J = 5-4 transition of C<sub>3</sub>O. A significant upper limit is set on the abundance of cyanocarbene (HCCN) as a result of the first reported interstellar search for this molecule.

Author

**A86-38140\*** Leiden Univ. (Netherlands).**INFRARED SPECTRAL IDENTIFICATION OF COMPLEX ORGANIC MOLECULES IN INTERSTELLAR GRAINS**

J. M. GREENBERG and W. SCHUTTE (Leiden, Rijksuniversiteit, Netherlands) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 145-150. refs (Contract NGR-33-018-148)

The chemical evolution of interstellar grains leads ultimately to a comparison consisting largely of complex organic molecules. Comparison of infrared absorption spectra of laboratory produced analogue materials with astronomical observations confirm the presence of similar molecules in interstellar space. The abundance

of this complex organic matter derived from the strength of the absorption bands is of the order of ten million solar masses and is almost certainly as large or larger than all conceivable planets.

Author

**A86-38141****UNIVERSAL PROTEIN ANCESTORS FROM HYDROGEN CYANIDE AND WATER**

C. N. MATTHEWS (Illinois, University, Chicago) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 151-156. refs

The crude organic solids which are formed in planetary, interplanetary and interstellar environments are analyzed, and connections are made between the components of these solids and the beginnings of life. It is proposed that a low energy route leading directly to the synthesis of heteropolypeptides, hydrogen cyanide and water is at the root of this cosmochemistry. The Miller-Urey paradigm is explained and laboratory and extraterrestrial data attest to the universality of the HCN polymerization process. This process accounts for both the past synthesis of protein ancestors on earth and reactions presently proceeding in the solar system, i.e., on planetary bodies around other stars and in the dusty molecular clouds of spiral galaxies. It is concluded that the existence of this preferred pathway enhances the probability that life is widespread throughout the universe. K.K.

**A86-38142****PANSPERMIA - A MODERN ASTROPHYSICAL AND BIOLOGICAL APPROACH**

J. M. GREENBERG and P. WEBER (Leiden, Rijksuniversiteit, Netherlands) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 157-164. refs

For the first time a laboratory simulation of the effect of the interstellar environment has been used to provide quantitative estimates of bacterial spore survival in the space between the stars. In the diffuse regions between clouds ten percent survival is limited to at most hundreds of years although one in ten thousand may survive for several thousand years. Within common dense clouds the ten percent life expectancy is extended to tens of millions of years because of the severely reduced ultraviolet within these clouds as well as because of the accretion of ultraviolet absorbing mantles on the spores. The random motion of molecular clouds is shown to provide a possible vehicle for transport of spores from one solar system to another. The most hazardous times in such a journey are at the start and finish and, although the requirements for survival during these periods are quantified here, the possibility or probability of their being satisfied remains pure conjecture.

Author

**A86-38143****NO VALID EVIDENCE EXISTS FOR INTERSTELLAR PROTEINS, BACTERIA, ETC**

R. E. DAVIES, A. M. DELLUVA, and R. H. KOCH (Pennsylvania, University, Philadelphia) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 165-169. refs

The claims for large biological molecules and for prokaryotic and eukaryotic organisms in the interstellar medium are summarized. These claims are compared with new UV laboratory spectra of numerous specimens. The results are incompatible with these claims.

Author

A86-38144

**ASTRONOMICAL SOURCES OF CIRCULARLY POLARIZED LIGHT AND THEIR ROLE IN DETERMINING MOLECULAR CHIRALITY ON EARTH**

R. D. WOLSTENCROFT (Royal Observatory, Edinburgh, Scotland) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 171-175. refs

A86-38145

**SYNTHESIS AND ANALYSIS IN CHEMICAL EVOLUTION**

C. PONNAMPERUMA (Maryland, University, College Park) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 185-197. refs

In the first part, the synthesis of the fundamental complex molecules of life (amino acids and their polymerization to proteins, lipids, sugars, purines and pyrimidines, and nucleic acids) from simple molecules ( $H_2O$ ,  $CH_4$ ,  $NH_3$ ,  $HCN$ ,  $CO_2$ , etc) under a variety of natural and laboratory conditions and sources of energy is examined. In the second part, the analysis of the data that confirm the early appearance of life on earth and the presence of complex organic compounds in a variety of environments (carbonaceous chondritic meteorites, the atmospheres of Jupiter and Titan, interstellar space, etc.) is examined. All these results confirm the universal effectiveness of chemical evolution. Author

A86-38148

**THE UNIVERSAL DIAGRAMS AND LIFE IN THE UNIVERSE**

M. KAFATOS (George Mason University, Fairfax, VA) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 245-249. refs

The simplest properties of all matter are compared in an effort to attain some insights about life that would apply elsewhere. Many classes of known objects in the universe are put on common plots, called universal diagrams. The quantities plotted are mass, size, luminous output, temperature, angular momentum and entropy change of the universe due to radiation by these objects. The mass-luminosity diagram is presented, and after being juxtaposed with information provided by the temperature-luminosity diagram, the mass-angular momentum diagram and the entropy change diagram, it is concluded that what is normally referred to as the universe, with R at about 10 to the 28th cm and M at about 10 to the 56th gr, is not in any other way different from the rest of the objects that it is supposed to contain. As far as animate life in the universe is concerned, intelligent creatures would have masses of a similar magnitude to humans. Moreover, their buildings and artifacts would also be similar in magnitude. The question of explosive objects is also addressed. K.K.

A86-38150

**ON THE OCCURRENCE AND APPEARANCE OF GALACTIC LIFE FORMS - A THERMODYNAMIC APPROACH**

G. BODIFEE and C. DE LOORE (Brussel, Vrije Universiteit, Brussels, Belgium) IN: The search for extraterrestrial life: Recent developments; Proceedings of the Symposium, Boston, MA, June 18-21, 1984. Dordrecht, D. Reidel Publishing Co., 1985, p. 255-259.

A86-38624

**IN THE BEGINNING . . . THERE WAS CLAY?**

R. SPANGENBURG and D. MOSER Space World (ISSN 0038-6332), vol. W-5-269, May 1986, p. 21-23.

Current NASA Ames research in support of the Cairns-Smith clay-life theory is discussed. The demonstration of the conversion, storage, and transfer of energy in clay supports the picture of clay as a prebiotic template for living organic matter. Such a template would allow fast chemical transitions and support the functions of adaptive behavior, self-replication, growth and repair, and the process of natural selection. The presence of clays in addition to amino acids in an uncontaminated carbonaceous

meteorite discovered in 1970 may also support the clay-life theory. R.R.

N86-26844\*# National Aeronautics and Space Administration, Washington, D.C.

**SECOND SYMPOSIUM ON CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE**

D. L. DEVINCENZI, ed. and P. A. DUFOUR, ed. (George Washington Univ., Washington, D.C.) May 1986 128 p refs Symposium held at Moffett Field, Calif., 23-26 Jul. 1985 (Contract NASW-3165) (NASA-CP-2425; NAS 1.55:2425) Avail: NTIS HC A07/MF A01 CSCL 06C

Recent findings by NASA Exobiology investigators are reported. Scientific papers are presented in the following areas: cosmic evolution of biogenic compounds, prebiotic evolution (planetary and molecular), early evolution of life (biological and geochemical), evolution of advanced life, solar system exploration, and the Search for Extraterrestrial Intelligence (SETI).

N86-26846\*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**CHARACTERIZATION OF BIOGENIC ELEMENTS IN INTERPLANETARY DUST PARTICLES**

T. E. BUNCH In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 41 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Those particles that were designated cometary are aggregates of amorphous materials including carbon, iron-magnesium silicates, sulfides, metal and trace amounts of unusual phases. Most aggregates are carbon-rich with major and minor element abundances similar to a fine grained matrix of carbonaceous chondrites. Several particles were analyzed by a laser microprobe. The negative ionic species identified to date include carbon clusters, protonated carbon clusters,  $CN^-$ ,  $HCN^-$ ,  $CNO^-$ ,  $PO_2^-$ ,  $PO_3^-$ ,  $S^-$ ,  $S_2^-$  and  $OH^-$ . These species are similar to those observed in cometary spectra and they support the assumption that organic materials are present. The occurrence of phosphate ions suggests the presence of apatite or whitlockite. Cometary particle characteristics may indicate that the component grains represent primitive unaltered dust whose overall properties are extremely similar to altered primitive dust in carbonaceous chondrites. Author

N86-26847\*# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.

**BOUNDARY CONDITIONS FOR THE PALEOENVIRONMENT: CHEMICAL AND PHYSICAL PROCESSES IN DENSE INTERSTELLAR CLOUDS**

W. M. IRVINE, F. P. SCHLOERB, and L. M. ZIURYS In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 42 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The present research includes searches for important new interstellar constituents; observations relevant to differentiating between different models for the chemical processes that are important in the interstellar environment; and coordinated studies of the chemistry, physics, and dynamics of molecular clouds which are the sites or possible future sites of star formation. Recent research has included the detection and study of four new interstellar molecules; searches which have placed upper limits on the abundance of several other potential constituents of interstellar clouds; quantitative studies of comparative molecular abundances in different types of interstellar clouds; investigation of reaction pathways for astrochemistry from a comparison of theory and the observed abundance of related species such as isomers and isotopic variants; studies of possible tracers of energetic events related to star formation, including silicon and sulfur containing molecules; and mapping of physical, chemical, and dynamical properties over extended regions of nearby cold molecular clouds. Author

**N86-26848\*#** Molecular Research Inst., Palo Alto, Calif.

# INTERSTELLAR ISOMERS

D. DEFREES, D. MCLEAN (IBM Research Lab., San Jose, Calif.), and E. HERBST (Duke Univ., Durham, N. C.) /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 43 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Both observational and theoretical studies of molecular clouds are hindered by many difficulties. One way to partially circumvent the difficulties of characterizing the chemistry within these objects is to study the relative abundances of isomers which are synthesized from a common set of precursors. Unfortunately, only one such system has been confirmed, the HCN/HNC pair of isomers. While the basic outlines of its chemistry have been known for some years, there are still many aspects of the chemistry which are unclear. Another potential pair of isomers is  $\text{HCO}^+/\text{HO}^+$ ;  $\text{HCO}^+$  is an abundant interstellar molecule and a tentative identification of  $\text{HO}^+$  has been made in Sgr B2. This identification is being challenged, however, based on theoretical and laboratory evidence that  $\text{HO}^+$  reacts with  $\text{H}_2$ . Another potential pair of interstellar isomers is methyl cyanide ( $\text{CH}_3\text{CN}$ , acetonitrile) and methyl isocyanide ( $\text{CH}_3\text{NC}$ ). The cyanide is well known, however the isocyanide has yet to be observed despite theoretical predictions that appreciable quantities should be present.

Author

**N86-26849\*#** Rensselaer Polytechnic Inst., Troy, N.Y.

# PHOTOLYSIS PRODUCTS OF CO, $\text{NH}_3$ AND $\text{H}_2\text{O}$ AND THEIR SIGNIFICANCE TO REACTIONS ON INTERSTELLAR GRAINS

J. P. FERRIS /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 44 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

With the increase in evidence that interstellar grains are the basic building blocks of comets and with the realization that comet collisions with the earth have probably occurred at a much higher frequency than earlier assumed it may be presumed that interstellar dust chemistry played an important role in the early chemistry of the earth. As a part of the study of the photochemical processes taking place on interstellar grains the photolysis of mixtures of CO,  $\text{NH}_3$  and  $\text{H}_2\text{O}$  was performed at 10 K, 77K and 298K. The reaction products were determined by GC/MS and HPLC analysis to be lactic acid, glycolic acid, hydroxyacetamide, urea, biuret, oxamic acid, oxamide, glyceric acid and glyceramide. Ethylene glycol and glycerol were also detected but is is not clear at present whether these are true photoproducts or contaminants. The mechanism of formation of these molecules are discussed as well as their possible significance to the origins of life.

Author

**N86-26850\*#** California Univ., Berkeley. Dept. of Astronomy.

# OBSERVATIONAL EXOBIOLGY

J. TARTER /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 45 May 1986 Prepared in cooperation with Search for Extraterrestrial Intelligence Inst., Los Altos, Calif.

Avail: NTIS HC A07/MF A01 CSCL 06C

The Earth's atmosphere absorbs partially or completely many ultraviolet, infrared and submillimeter wavelengths. Atmospheric seeing distorts small images, imposing a limit on the achievable angular resolution at optical and infrared wavelengths that is much poorer than the intrinsic capability of telescope optics. The atomic and molecular species of the atmosphere confuse or prevent the spectral studies of similar compounds outside of the terrestrial environment. Telescopes placed in orbit above the atmosphere avoid these problems and enjoy a unique view of the universe. There are many complex questions pertaining to the origin and evolution of the biogenic elements and compounds and the existence of terrestrial types of planets elsewhere that can be only tackled from orbiting facilities. The detailed nature of the spacecraft, platforms and instrumentation most likely to be launched by the United States and Europe in the near future in an attempt to determine what observational programs would be tractable and which areas of interest to exobiology required

hardware capabilities beyond those currently envisioned are considered.

Author

**N86-26852\*#** Cornell Univ., Ithaca, N.Y. Lab. for Planetary Studies.

# THE ORGANIC AEROSOLS OF TITAN

B. N. KHARE, C. SAGAN, W. R. THOMPSON, E. T. ARAKAWA, F. SUITS, T. A. CALCOTT, M. W. WILLIAMS, S. SHRADER, H. OGINO, T. O. WILLINGHAM et al. /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 48 May 1986 Submitted for publication

Avail: NTIS HC A07/MF A01 CSCL 06C

A dark reddish organic solid, called tholin, is synthesized from simulated Titanian atmospheres by irradiation with high energy electrons in a plasma discharge. The visible reflection spectrum of this tholin is found to be similar to that of high altitude aerosols responsible for the albedo and reddish color of Titan. The real (n) and imaginary (k) parts of the complex refractive index of thin films of Titan prepared by continuous dc discharge through a 0.9  $\text{N}_2/0.1 \text{ CH}_4$  gas mixture at 0.2 mb is determined from X-ray to microwave frequencies. Values of n (approx. 1.65) and k (approx. 0.004 to 0.08) in the visible are consistent with deductions made by groundbased and spaceborne observations of Titan. Many infrared absorption features are present in  $k(\lambda)$ , including the 4.6 micrometer nitrile band. Molecular analysis of the volatile components of this tholin was performed by sequential and nonsequential pyrolytic gas chromatography/mass spectrometry. More than one hundred organic compounds are released; tentative identifications include saturated and unsaturated aliphatic hydrocarbons, substituted polycyclic aromatics, nitriles, amines, pyrroles, pyrazines, pyridines, pyrimidines, and the purine, adenine. In addition, acid hydrolysis produces a racemic mixture of biological and nonbiological amino acids. Many of these molecules are implicated in the origin of life on Earth, suggesting Titan as a contemporary laboratory environment for prebiological organic chemistry on a planetary scale.

Author

**N86-26853\*#** Harvard Univ., Cambridge, Mass.

# THE D TO H RATIO ON TITAN AND THE PLANETS: IMPLICATIONS FOR ORIGIN AND EVOLUTION OF PLANETARY ATMOSPHERES

J. P. PINTO, J. I. LUNINE (California Inst. of Tech., Pasadena), S. J. KIM, and Y. L. YUNG /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 49 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Measurements of deuterated methane show that Titan's atmosphere is enriched by at least several times in deuterium compared to the major planets. Potential causative factors for this enrichment are condensation to form tropospheric methane clouds, fractionation occurring over a hypothetical  $\text{CH}_4\text{-C}_2\text{H}_2$  ocean and between the ocean and the clathrate crust beneath, fractionation which occurred during the formation of Titan and fractionation occurring as a result of the evolution of Titan's atmosphere. The greater part of the observed fractionation is probably derived from the formation of Titan and the subsequent evolution of Titan atmosphere driven by photochemistry. The latter process is developed here for the first time. The D/H ratio in a planetary atmosphere is one readily available measure of the origin and evolution of the hydrogen bearing volatiles on the planet. Comparison between D/H ratio in the inner solar system and the outer solar system may pose important constraints on current theories.

Author



**N86-26856\*#** National Aeronautics and Space Administration, Washington, D.C.

**A GAS CHROMATOGRAPH EXPERIMENT FOR A TITAN ENTRY PROBE**

G. C. CARLE, D. R. KOJIRO, B. J. OHARA, J. R. VALENTIN, V. R. W. OBERBECK, and T. W. SCATTERGOOD (State Univ. of New York, Stony Brook) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 53 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Development of a gas chromatographic technique for analysis of aerosols and volatile organics from a Titan probe is now in progress. Preliminary investigations of aerosol collectors have shown that an electrostatic device should be the most efficient for the particle sizes expected in Titan's atmosphere. Such a device particularly lends itself to development of a simple pyrolyzer which can be used to break down any collected organic conglomerate structures into volatile fragments. Those fragments can subsequently be analyzed by GC providing information about the original chemical structure of the aerosols. Studies show that as little as 1 to 5 micrograms of model aerosol can be successfully analyzed. High altitude atmospheric gas sampling will also be important on Titan due to the great depth of the atmosphere. Studies show that a GC analysis of model Titan atmospheres at pressures approximating this altitude can be made with a sensitivity of a few ten's of parts-per-billion for the trace gases of interest.

Author

**N86-26857\*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**MOLECULAR AND ELEMENTAL DUST ANALYZER (MEDA) FOR THE COMET RENDEZVOUS ASTEROID FLYBY MISSION**

B. J. OHARA, G. C. CARLE, and B. C. CLARK (Martin Marietta Aerospace, Denver, Colo.) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 54 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Comets are some of the most primitive bodies in the solar system and therefore should contain elemental, chemical, and isotopic records of the early history of the solar system. An opportunity to perform in situ analyses of a comet nucleus exists with the Comet Rendezvous Asteroid Flyby (CRAF) mission. An integrated gas chromatograph/X-ray fluorescence instrument (MEDA), being proposed for inclusion onboard the CRAF spacecraft, will measure the molecular and elemental constituents of collected dust grains and ices. The gas chromatograph, employing helium ionization detectors and three columns designed to separate light gases, polar gases, and hydrocarbons will measure the volatile compounds of the biogenic elements thermally released from collected dust grains. The sensitivity of the GC for compounds of interest is at the picogram level. X-ray fluorescence utilized cryogenically cooled Si(Li) solid state detectors of nominal 150 eV resolution at 5.9 keV. Based on laboratory work with carbonaceous meteorites, both the GC and XRF can perform meaningful analyses with a few micrograms of collected comet dust.

Author

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**INVESTIGATION OF POROUS POLYMER GAS CHROMATOGRAPHIC PACKINGS FOR ATMOSPHERIC ANALYSIS OF EXTRATERRESTRIAL BODIES**

G. E. POLLOCK *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 55 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Measurement of the permanent gases in the atmospheres of mission targets is a major objective. A 16 meter long Porapak N column was used on the Venus probe and required a rather high carrier gas flow rate. The researchers have, therefore, surveyed commercial porous polymer types which had some ability to resolve nitrogen, oxygen, argon and carbon monoxide gases. Porapaks N and Q appeared superior to most. Batch to batch variation,

however, was quite wide, so the researchers learned how to synthesize porous polymer and investigated some of the factors affecting the separations. A polymer was synthesized which was superior to all commercial products and allowed at least a 50% reduction in length and flow rate of carrier gas. Similar studies were made concerning the separation of hydrocarbons and new porous polymers have been synthesized which represent significant improvements in time of analysis, column, and carrier gas flow rate.

Author

**N86-26859\*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**MINIATURE METASTABLE IONIZATION DETECTORS FOR EXOBIOLOGY FLIGHT EXPERIMENTS**

F. H. WOELLER *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 56 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The Metastable Ionization Detector (MID) is three orders of magnitude more sensitive than the thermal conductivity detectors used on previous flight instruments. The miniature MID provides scientists with a much smaller and highly sensitive detector for flight gas chromatographs. A miniature MID featuring an unconventional triaxial electrode configuration was developed and used routinely in the laboratory. Although much smaller and lighter than the commercial MID, its performance characteristics parallel those of the traditional design. The detector is compatible with the modulated voltage circuitry, also developed here, and thus can perform over an expanded response range of more than 7 orders magnitude. A micro volume version of a miniature MID, with an internal volume of less than 8 microliter, was recently designed is now being tested. The micro volume MID uses carrier gas flow rates of approx. 2cc/min thus eliminating the need for makeup gas when capillary columns are used.

Author

**N86-26860\*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**MULTIPLEX GAS CHROMATOGRAPHY: A NOVEL ANALYTICAL TECHNIQUE FOR FUTURE PLANETARY STUDIES**

J. R. VALENTIN, G. C. CARLE, and J. B. PHILLIPS (University of Southern Illinois, Carbondale) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 57 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Determination of molecular species comprised of the biogenic elements in the atmospheres of planets and moons of the solar system is one the foremost requirements of the exobiologist studying chemical evolution and the origin of life. Multiplex chromatography is a technique where many samples are pseudo-randomly introduced to the chromatograph without regard to elution of preceding components. The resulting data are then reduced using mathematical techniques such as cross correlation or Fourier Transforms. To demonstrate the utility of this technique for future solar system exploration, chemical modulators were developed. Several advantages were realized from this technique in combination with these modulators: improvement in detection limits of several orders of magnitude, improvement in the analysis of complex mixtures by selectively modulating some of the components present in the sample, increase in the number of analyses that can be conducted in a given period of time, and reduction in the amount of expendables needed to run an analysis. In order to apply this technique in a real application, methane in ambient air was monitored continuously over a period of one week. By using ambient air as its own carrier all expendables beyond power were eliminated.

Author



**N86-26861\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**ION MOBILITY DRIFT SPECTROMETER (IMDS) AS A FLIGHT ANALYTICAL INSTRUMENT TECHNIQUE**

D. R. KOJIRO and G. C. CARLE /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 58 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

A detailed knowledge of the history and abundances of the biogenic elements and their compounds throughout the solar system can provide the exobiologists with a basis for understanding the conditions necessary for chemical evolution and the origin of life. The Ion Mobility Drift Spectrometer is an ion molecule reactor coupled with an ion drift spectrometer. Sample molecules are ionized to form product ions in the reactant region. An electric field moves the ions through a drift region against the flow of a drift gas where they are separated according to their size and structure producing an ion mobility spectrum. These spectra provide the IMDS with virtually universal sample identification capability. To conform to the rigid limits of weight, volume and consumables placed on flight instrumentation, several aspects of the IMDS must be studied and redesigned for flight use. In addition to miniaturization of the instrument, a reduction in the high flow rates used for the drift gas is an obvious necessary consideration. The effect of drastically reduced drift flow rates on IMDS spectra was investigated by lowering flow rates from 500ml/min to 50ml/min. Changes in peak shape, drift time and total spectra were studied at each flow rate.

Author

**N86-26863\*#** California Univ., San Diego, La Jolla. Dept. of Chemistry.

**ENERGY YIELDS IN THE PREBIOTIC SYNTHESIS OF HYDROGEN CYANIDE AND FORMALDEHYDE**

R. STRIBLING and S. L. MILLER /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 61 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Prebiotic experiments are usually reported in terms of carbon yields, i.e., the yield of product based on the total carbon in the system. These experiments usually involve a large input of energy and are designed to maximize the yields of product. However, large inputs of energy result in multiple activation of the reactants and products. A more realistic prebiotic experiment is to remove the products of the activation step so they are not exposed a second time to the energy source. This is equivalent to transporting the products synthesized in the primitive atmosphere to the ocean, and thereby protecting them from destruction by atmospheric energy sources. Experiments of this type, using lower inputs of energy, give energy yields (moles of products/joule) which can be used to estimate the relative importance of the different energy sources on the primitive earth. Simulated prebiotic atmospheres containing either CH<sub>4</sub>, CO or CO<sub>2</sub> with N<sub>2</sub>, H<sub>2</sub>O and variable amounts of H<sub>2</sub> were subjected to a high frequency Tesla coil. Samples of the aqueous phase were taken at various time intervals from 1 hr to 7 days, and the energy yields were obtained by extrapolation to zero time. The samples were analyzed for HCN with the cyanide electrode and for H<sub>2</sub>CO by chromatographic acid. The spark energy was estimated by calorimetry. The temperature rise in an insulated discharge flask was compared with the temperature rise from a resistance heater in the same flask. These results will be compared with calculated production rates of HCN and H<sub>2</sub>CO from lightning and a number of photochemical processes on the primitive Earth.

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**SYNTHESIS AND ANALYSIS IN STUDIES OF CHEMICAL EVOLUTION**

C. PONNAMPERUMA, M. K. HOBISH, K. KOBAYASHI, L. L. HUA, and N. SENARATNE /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 62 May 1986

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Studies of the various processes that may have given rise to life on the Earth have demonstrated the appropriateness of an approach that makes use of analysis and synthesis. Analysis of extraterrestrial samples in the form of meteorites has demonstrated the presence of several precursors of biomolecules, most notably a full suite of nucleic acid bases and nucleotides of biological significance. These species were determined after exhaustive extraction of the sample and subsequent analysis using HPLC, GC, MS, and GC-MS. Procedural blanks indicate that these molecules are likely not the result of contamination during the extraction and analysis process. Similar species were found as products of spark discharge experiments in atmospheres thought to mimic primitive Earth conditions. These results indicate that the basic chemistry underlying these syntheses is common, and that life may not be unique to the Earth. Studies underway in the laboratory make use of proton nuclear magnetic resonance spectroscopy as a probe to assess associations between selected amino acids and any of several nucleotides comprising their genetic code and genetic anticode sequences. These studies demonstrate a clear selectivity by the anticode sequences, thus confirming the hydrophobicity studies performed by Lacey et al. These studies further support the contention that life is likely a natural result of the physics and chemistry of the universe.

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**ISOTOPIC CHARACTERISATION OF PREBIOTIC SYNTHESIS OF ORGANIC MATERIAL**

J. F. KERRIDGE (California Univ., Los Angeles.) and S. CHANG /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 63 May 1986

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Many primitive meteorites contain an insoluble organic material, much like terrestrial kerogen, whose mode of origin is currently unknown. When subjected to stepwise decomposition, this material, unlike its terrestrial counterpart, reveals characteristic release patterns for the stable isotopes of carbon, hydrogen and nitrogen as a function of fractional release of each element. The purpose of this study is to try to match those release patterns using organic matter synthesised in the laboratory under controlled conditions. If successful, such a study would shed light on the origin of kerogen-like organic matter in the early solar system and, by extension, on prebiotic organic synthesis in general. The range of possible syntheses, starting materials and reaction conditions to be investigated is considerable. Samples analysed to date include: a heavy oil produced by Fischer-Tropsch-type catalysis of CO + H<sub>2</sub>; a solid residue generated by a plasma discharge in CO + H<sub>2</sub> + N<sub>2</sub>; a solid deposited on the electrodes of a Miller-Urey synthesis operating on CH<sub>4</sub> + H<sub>2</sub>O + N<sub>2</sub>; and a solid residue formed by polymerization of light hydrocarbons procured by a Miller-Urey discharge acting on CH<sub>4</sub>. Significant structure is observed in the release patterns for the carbon and hydrogen isotopes from the synthetic samples, though there is little evidence for isotopic fractionation during the analysis itself.

Author

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**ORIGIN OF LIFE AND IRON-RICH CLAYS**

H. H. HARTMAN /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 64 May 1986

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The premise that life began with self-replicating iron-rich clays is explored. In association with these clays and UV light, polar organic molecules, such as oxalic acid, were synthesized. The

carbonaceous chondrites have both iron-rich clays and organic molecules. It is convenient to classify meteoritic organic matter into 3 categories: insoluble polymer, hydrocarbons and polar organics (soluble in water). Recent work on the delta D, delta N-15 and delta C-13 has made it clear that these three fractions have been made by three different mechanisms. A significant fraction of the insoluble polymer has a delta-D which suggests that it was made in an interstellar medium. The hydrocarbons seem to have been made on a parent body by a Fischer-Tropsch mechanism. The polar organics were probably synthesized in a mixture of carbonate  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{Fe}(++)$  ion and liquid water by radiolysis. In a set of experiments the radiolysis of  $(\text{NH}_4)_2\text{CO}_3$  in the presence and absence of  $\text{Fe}(++)$  ion has been examined. The synthesis of glycine in the presence of  $\text{Fe}(++)$  ion is 3-4 times that in the absence of ferrous ion. The effects of the addition of hydrocarbons to this mixture are explored. Iron-rich clays at low temperature and pressure are synthesized. So far the results are not sufficiently crystalline to look for replication. It should be noted that organic chelating agents such as oxalic acid do increase the crystallinity of the clays but not sufficiently. The hydrothermal synthesis of iron-rich clays is being examined. Author

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#### CLAY ENERGETICS IN CHEMICAL EVOLUTION

L. M. COYNE /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 65 May 1986

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Clays have been implicated in the origin of terrestrial life since the 1950's. Originally they were considered agents which aid in selecting, concentrating and promoting oligomerization of the organic monomeric substituents of cellular life forms. However, more recently, it has been suggested that minerals, with particular emphasis on clays, may have played a yet more fundamental role. It has been suggested that clays are prototypic life forms in themselves and that they served as a template which directed the self-assembly of cellular life. If the clay-life theory is to have other than conceptual credibility, clays must be shown by experiment to execute the operations of cellular life, not only individually, but also in a sufficiently concerted manner as to produce some semblance of the functional attributes of living cells. Current studies are focussed on the ability of clays to absorb, store and transfer energy under plausible prebiotic conditions and to use this energy to drive chemistry of prebiotic relevance. Conclusions of the work are applicable to the role of clays either as substrates for organic chemistry, or in fueling their own life-mimetic processes. Author

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#### FURTHER WORK ON SODIUM MONTMORILLONITE AS CATALYST FOR THE POLYMERIZATION OF ACTIVATED AMINO ACIDS

F. R. EIRICH and M. PAECHT-HOROWITZ (Hebrew Univ. of Jerusalem, Rehovot (Israel).) /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 66 May 1986

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When the polycondensation of amino acid acylates was catalyzed with Na-montmorillonite, the polypeptides were consistently found to exhibit a distribution of discrete molecular weights, for as yet undiscovered reasons. One possible explanation was connected to the stepwise mode of monomer addition. New experiments have eliminated this possibility, so that there is the general assumption that this discreteness is the result of a preference of shorter oligomers to add to others of the same length, a feature that could be attributed to some structure of the platelet aggregates of the montmorillonite. The production of optical stereoisomers is anticipated when D,L-amino acids are polymerized on montmorillonite. Having used an optically active surface, the essence of the results lies not only in the occurrence of optically active oligomers and polymers, but also in the fact that the latter exhibit the same molecular weight characteristics as the D,L-polymers. Preparatory to work contemplated on a parallel

synthesis of amino acid and nucleotide oligomers, studies were continued on the co-adsorption of amino acids, nucleotides, and amino acid-nucleotides on montmorillonite. Author

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#### ADSORPTION AND CONDENSATION OF AMINO ACIDS AND NUCLEOTIDES WITH SOLUBLE MINERAL SALTS

J. ORENBERG and N. LAHAV (Hebrew Univ. of Jerusalem, Rehovot (Israel).) /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 67 May 1986

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The directed synthesis of biopolymers in an abiotic environment is presumably a cyclic sequence of steps which may be realized in a fluctuating environment such as a prebiotic pond undergoing wetting-drying cycles. Soluble mineral salts have been proposed as an essential component of this fluctuating environment. The following sequence may be considered as a most primitive mechanism of information transfer in a fluctuating environment: (1) adsorption of a biomolecule onto a soluble mineral salt surface to act as an adsorbed template; (2) specific adsorption of biomonomers onto the adsorbed template; (3) condensation of the adsorbed biomonomers; and (4) desorption of the elongated oligomer. In this investigation, the salts selected for study were  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  (gypsum),  $\text{SrSO}_4$ , and several other metal sulfates and chlorides. Adsorption of the monomeric species, gly, 5'AMP 5'GMP, and 5'CMP was investigated. The adsorbed template biopolymers used were Poly-A, Poly-G, Poly-C, and Poly-U. The results of studies involving these experimental participants, the first two steps of the proposed primitive information transfer mechanism, and condensation of amino acids to form oligomers in a fluctuating environment are to be reported. Author

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#### PALEOSOLS AND THE CHEMICAL EVOLUTION OF THE ATMOSPHERE

H. D. HOLLAND, E. A. ZBINDEN, and J. P. PINTO /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 68 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The chemistry and mineralogy of soils reflects the chemistry of the atmosphere below which they develop. Today the presence of a cover of land plants can obscure the signature of a highly oxidizing atmosphere. Prior to the advent of higher land plants ca. 400 m.y. ago the obscuring effect of a biological interface should have been minor. It can be shown that under such conditions the behavior of ferrous iron during weathering depends on the relationship between the ratio of the net concentration of oxidants to the concentration of acids in rainwater, and on the ratio of the oxygen demand to the acid demand for complete weathering of the parent rock. An analysis of the behavior of iron in some 15 paleosols between 1.0 and 2.9 b.y. in age showed some time ago that iron was retained, or largely retained, in paleosols developed on rocks with a low ratio of oxidant demand to acid demand (R value) and was lost from paleosols with a high R value. The results indicate that between 1.1 and 2.9 b.y.b.p. the ratio of the net concentration of oxidants to  $\text{CO}_2$  in rainwater was less than ca. 1/600 of the present-day value. Work during the past year has sought to extend the data base for paleosols and to define more precisely the relationships between the composition of paleosols and the chemistry of the atmosphere below which they developed. Author

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#### COOPERATION OF CATALYSTS AND TEMPLATES

D. H. WHITE, A. KANAVARIOTI, C. W. NIBLEY, and J. W. MACKLIN (Washington Univ., Seattle.) /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 69 May 1986

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In order to understand how self-reproducing molecules could have originated on the primitive Earth or extraterrestrial bodies, it

would be useful to find laboratory models of simple molecules which are able to carry out processes of catalysis and templating. Furthermore, it may be anticipated that systems in which several components are acting cooperatively to catalyze each other's synthesis will have different behavior with respect to natural selection than those of purely replicating systems. As the major focus of this work, laboratory models are devised to study the influence of short peptide catalysts on template reactions which produce oligonucleotides or additional peptides. Such catalysts could have been the earliest protoenzymes of selective advantage produced by replicating oligonucleotides. Since this is a complex problem, simpler systems are also studied which embody only one aspect at a time, such as peptide formation with and without a template, peptide catalysis of nontemplated peptide synthesis, and model reactions for replication of the type pioneered by Orgel. Author

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**MOLECULAR MICROENVIRONMENTS: SOLVENT INTERACTIONS WITH NUCLEIC ACID BASES AND IONS**

R. D. MACELROY and A. POHORILLE (California Univ., Berkeley.) /n NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 70 May 1986  
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The possibility of reconstructing plausible sequences of events in prebiotic molecular evolution is limited by the lack of fossil remains. However, with hindsight, one goal of molecular evolution was obvious: the development of molecular systems that became constituents of living systems. By understanding the interactions among molecules that are likely to have been present in the prebiotic environment, and that could have served as components in protobiotic molecular systems, plausible evolutionary sequences can be suggested. When stable aggregations of molecules form, a net decrease in free energy is observed in the system. Such changes occur when solvent molecules interact among themselves, as well as when they interact with organic species. A significant decrease in free energy, in systems of solvent and organic molecules, is due to entropy changes in the solvent. Entropy-driven interactions played a major role in the organization of prebiotic systems, and understanding the energetics of them is essential to understanding molecular evolution. Author

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**INTRAMOLECULAR INTERACTIONS IN AMINOACYL NUCLEOTIDES: IMPLICATIONS REGARDING THE ORIGIN OF GENETIC CODING AND PROTEIN SYNTHESIS**

J. C. LACEY, JR., D. W. MULLINS, JR., C. L. WATKINS, and L. M. HALL /n NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 71 May 1986  
Avail: NTIS HC A07/MF A01 CSCL 06C

Cellular organisms store information as sequences of nucleotides in double stranded DNA. This information is useless unless it can be converted into the active molecular species, protein. This is done in contemporary creatures first by transcription of one strand to give a complementary strand of mRNA. The sequence of nucleotides is then translated into a specific sequence of amino acids in a protein. Translation is made possible by a genetic coding system in which a sequence of three nucleotides codes for a specific amino acid. The origin and evolution of any chemical system can be understood through elucidation of the properties of the chemical entities which make up the system. There is an underlying logic to the coding system revealed by a correlation of the hydrophobicities of amino acids and their anticodon nucleotides (i.e., the complement of the codon). Its importance lies in the fact that every amino acid going into protein synthesis must first be activated. This is universally accomplished with ATP. Past studies have concentrated on the chemistry of the adenylates, but more recently we have found, through the use of NMR, that we can observe intramolecular interactions even at low concentrations, between amino acid side chains and nucleotide base rings in these adenylates. The use of this type of compound

thus affords a novel way of elucidating the manner in which amino acids and nucleotides interact with each other. In aqueous solution, when a hydrophobic amino acid is attached to the most hydrophobic nucleotide, AMP, a hydrophobic interaction takes place between the amino acid side chain and the adenine ring. The studies to be reported concern these hydrophobic interactions. Author

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**MOLECULAR REPLICATION**

L. E. ORGEL /n NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 72 May 1986

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The object of our research program is to understand how polynucleotide replication originated on the primitive Earth. This is a central issue in studies of the origins of life, since a process similar to modern DNA and RNA synthesis is likely to have formed the basis for the most primitive system of genetic information transfer. The major conclusion of studies so far is that a preformed polynucleotide template under many different experimental conditions will facilitate the synthesis of a new oligonucleotide with a sequence complementary to that of the template. It has been shown, for example, that poly(C) facilitates the synthesis of long oligo(G)s and that the short template CCGCC facilitates the synthesis of its complement GGCGG. Very recently we have shown that template-directed synthesis is not limited to the standard oligonucleotide substrates. Nucleic acid-like molecules with a pyrophosphate group replacing the phosphate of the standard nucleic acid backbone are readily synthesized from deoxynucleotide 3'-5'-diphosphates on appropriate templates. Author

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**STERESELECTIVE AMINOACYLATION OF RNA**

D. A. USHER, M. C. NEEDELS, and T. BRENNER /n NASA, Washington Symposium on Chemical Evolution and the Origin and Evolution of Life p 73 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Prebiotic chemistry is faced with a major problem: how could a controlled and selective reaction occur, when there is present in the same solution a large number of alternative possible coreactants? This problem is solved in the modern cell by the presence of enzymes, which are not only highly efficient and controllable catalysts, but which also can impose on their substrates a precise structural requirement. However, enzymes are the result of billions of years of evolution, and we cannot invoke them as prebiotic catalysts. One approach to solving this problem in the prebiotic context is to make use of template-directed reactions. These reactions increase the number of structural requirements that must be simultaneously present in a molecule for it to be able to react, and thereby increase the selectivity of the reaction. They also can give a large increase in the rate of a reaction, if the template constrains two potential coreactants to lie close together. A third benefit is that information that is present in the template molecule can be passed on to the product molecules. If the earliest organisms were based on proteins and nucleic acids, then the investigation of peptide synthesis on an oligonucleotide template is highly relevant to the study of the origin of life. Author

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**MODELS OF GLYCOLYSIS: GLYCERALDEHYDE AS A SOURCE OF ENERGY AND MONOMERS FOR PREBIOTIC CONDENSATION REACTIONS**

A. L. WEBER /n NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 74 May 1986

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All organisms require energy in a chemical form for maintenance and growth. In contemporary life this chemical energy is obtained by the synthesis of the phosphoanhydride bonds of ATP. Among the biological processes that yield ATP, fermentation is generally

considered primitive, because it operates under anaerobic conditions by substrate-level phosphorylation which does not require compartmentation by membranes. Fermentation by the glycolytic pathway, which is found in almost every living cell, is an especially attractive energy source for primitive life. Glycolysis not only produces useful chemical energy (ATP), but intermediates of this pathway are also involved in amino acid synthesis and photosynthetic carbon-fixation. It is believed that energy and substrates needed for the origin of life were provided by nonenzymatic chemical reactions that resemble the enzyme-mediated reactions of glycolysis. These nonenzymatic reactions would have provided a starting point for the evolutionary development of glycolysis. Author

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#### **A COMPARATIVE STUDY OF PREBIOTIC AND PRESENT DAY TRANSLATIONAL MODELS**

R. REIN, G. RAGHUNATHAN, J. MCDONALD, M. SHIBATA, and S. SRINIVASAN /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 75 May 1986

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It is generally recognized that the understanding of the molecular basis of primitive translation is a fundamental step in developing a theory of the origin of life. However, even in modern molecular biology, the mechanism for the decoding of messenger RNA triplet codons into an amino acid sequence of a protein on the ribosome is understood incompletely. Most of the proposed models for prebiotic translation lack, not only experimental support, but also a careful theoretical scrutiny of their compatibility with well understood stereochemical and energetic principles of nucleic acid structure, molecular recognition principles, and the chemistry of peptide bond formation. Present studies are concerned with comparative structural modelling and mechanistic simulation of the decoding apparatus ranging from those proposed for prebiotic conditions to the ones involved in modern biology. Any primitive decoding machinery based on nucleic acids and proteins, and most likely the modern day system, has to satisfy certain geometrical constraints. The charged amino acyl and the peptidyl termini of successive adaptors have to be adjacent in space in order to satisfy the stereochemical requirements for amide bond formation. Simultaneously, the same adaptors have to recognize successive codons on the messenger. This translational complex has to be realized by components that obey nucleic acid conformational principles, stabilities, and specificities. This generalized condition greatly restricts the number of acceptable adaptor structures. Author

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#### **PROTOBIOLOGICAL INFORMATION, BIDIRECTIONAL RECOGNITION AND REVERSE TRANSLATION**

S. W. FOX, T. NAKASHIMA, A. PRZYBYLSKI, and G. VAUGHAN /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 76 May 1986

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Emergence of protobiological information has been suggested by experiments in which heated mixtures of alpha-amino acids order themselves into a self limited array of thermal proteins. The polymers display selective catalytic, hormonal, and other activities. Interactions of varied cationic thermal proteins with polynucleotides indicate selective recognition in both directions. Reverse translation is partly a missing link in the molecular evolution flowsheet. The self ordering of amino acids serves conceptually as a deterministic evolutionary precursor of the modern coding mechanism. The possibility for the evolution of information at an early nontemplated protein stage is supported by findings of electrical signals from proteinoid microspheres prepared with no DNA/RNA in their history. The deposition of thermal copolyamino acids on lipid membranes in the Mueller-Rudin apparatus has here been found to produce electrical behavior like that evoked by bacterial EIM polypeptide. A new procedure is to make a film of membrane on the electrode;

the results provide maximal repeatability. The principle of nonrandom biomacromolecular specificity identified by these studies in molecular evolution have been extrapolated to principles of evolution of advanced organisms. Author

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#### **PHOTOCHEMICAL REACTIONS OF VARIOUS MODEL PROTOCELL SYSTEMS**

C. E. FOLSOME /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 77 May 1986

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Models for the emergence of cellular life on the primitive Earth, and for physical environments of that era have been studied that embody these assumptions: (1) pregenetic cellular forms were phase-bounded systems primarily photosynthetic in nature, and (2) the early Earth environment was anoxic (lacking appreciable amounts of free hydrogen). It was found that organic structures can also be formed under anoxic conditions ( $N_2$ ,  $CO_3=$ ,  $H_2O$ ) by protracted longwavelength UV radiation. Apparently these structures form initially as organic layers upon  $CaCO_3$  crystalloids. The question remains as to whether the UV photosynthetic ability of such phase bounded structures is a curiosity, or a general property of phase bounded systems which is of direct interest to the emergence of cellular life. The question of the requirement and salient features of a phase boundary for UV photosynthetic abilities was addressed by searching for similar general physical properties which might be manifest in a variety of other simple protocell-like structures. Since it has been shown that laboratory protocell models can effect the UV photosynthesis of low molecular weight compounds, this reaction is being used as an assay to survey other types of structures for similar UV photosynthetic reactions. Various kinds of structures surveyed are: (1) proteinoids; (2) liposomes; (3) reconstituted cell membrane spheroids; (4) coacervates; and (5) model protocells formed under anoxic conditions. M.G.

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#### **THE PRINCIPLE OF COOPERATION AND LIFE'S ORIGIN AND EVOLUTION**

J. ORO, G. ARMANGUE, and A. MAR /*In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 78 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

In simple terms a living entity is a negentropic system that replicates, mutates and evolves. A number of suggestions have been made, such as directed panspermia, atmospheric photosynthesis, genetic overtaking from inorganic processes, etc., as alternative models to the accepted Oparin-Haldane-Urey model of the origin of life on Earth. This has probably occurred because in spite of tremendous advances in the prebiotic synthesis of biochemical compounds, the fundamental problem of the appearance of the first life—a primordial replicating cell-ancestral to all other forms of extant life, has remained elusive. This is indeed a reflection on the different fundamental nature of the problem involved. Regardless of which were the fundamental processes which occurred on the primitive Earth, it has to end up with the fundamental characteristics of an ancestral protocell. The problem of the emergence of the first ancestral cell was one of synergistic macromolecular cooperation, as it has been discussed by authors recently (COSPAR XXV Plenary Meeting). An analogous situation must have occurred at the time of the appearance of the first eucaryotic organism. Procaryotic life appeared probably during the first 600 million years of Earth history when the Earth was sufficiently cool and continually bombarded (in the late accretion period) by comets and minor bodies of the solar system, when the sea had not yet acquired its present form. Author

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**BASE PAIRING AND BASE MIS-PAIRING IN NUCLEIC ACIDS**

A. H. J. WANG and A. RICH *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 78 May 1986

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In recent years we have learned that DNA is conformationally active. It can exist in a number of different stable conformations including both right-handed and left-handed forms. Using single crystal X-ray diffraction analysis we are able to discover not only additional conformations of the nucleic acids but also different types of hydrogen bonded base-base interactions. Although Watson-Crick base pairings are the predominant type of interaction in double helical DNA, they are not the only types. Recently, we have been able to examine mismatching of guanine-thymine base pairs in left-handed Z-DNA at atomic resolution (1Å). A minimum amount of distortion of the sugar phosphate backbone is found in the G x T pairing in which the bases are held together by two hydrogen bonds in the wobble pairing interaction. Because of the high resolution of the analysis we can visualize water molecules which fill in to accommodate the other hydrogen bonding positions in the bases which are not used in the base-base interactions. Studies on other DNA oligomers have revealed that other types of non-Watson-Crick hydrogen bonding interactions can occur. In the structure of a DNA octamer with the sequence d(GCGTACGC) complexed to an antibiotic triostin A, it was found that the two central AT base pairs are held together by Hoogsteen rather than Watson-Crick base pairs. Similarly, the G x C base pairs at the ends are also Hoogsteen rather than Watson-Crick pairing. Hoogsteen base pairs make a modified helix which is distinct from the Watson-Crick double helix. Author

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**EARTH'S EARLY ATMOSPHERE AS SEEN FROM CARBON AND NITROGEN ISOTOPIC ANALYSIS OF ARCHEAN SEDIMENTS**

E. K. GIBSON, JR., L. P. CARR, I. GILMOUR (Open Univ., Milton, England), and C. T. PILLINGER *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 82 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The origin and evolution of the Earth's early atmosphere has long been a topic of great interest but determination of actual compositions over geologic time is a difficult problem. However, recent systematic studies of stromatolite deposits (Precambrian Paleobiology Research Group) has extended our knowledge of Archean ecosystems. It has been shown that many stromatolite deposits have undergone negligible alteration since their time of formation. The discovery of primary fluid inclusions within unaltered 3.5 b.y. old Archean sediments and the observation that the 3.3 b.y. old Barberton cherts have remained closed to argon loss and have not been subjected to thermal metamorphism suggests that an opportunity exists for the direct measurement of the volatile constituents present at their time of formation. Of primary interest to this study was the possibility that the stromatolites and other Archean sediments might retain a vestige of the atmosphere and thus afford an indication of the variations in carbon dioxide and nitrogen isotopic compositions with time. A suite of essentially unaltered Archean stromatolites and the cherts of different ages and geologic sites have been analyzed for their trapped carbon dioxide and nitrogen compositions by the stepped combustion extraction technique utilizing static mass spectrometers for the isotope measurements. Author

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**CARBON EXCHANGE BETWEEN THE MANTLE AND THE CRUST AND ITS EFFECT UPON THE ATMOSPHERE: TODAY COMPARED TO ARCHEAN TIME**

D. DESMARAIS *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 81 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Paleobiologists now recognize that the Earth's biosphere has been profoundly affected by geologic processes. One very important process is the dissipation of heat which has been generated by radioactivity and/or stored within the earth. Heat flow is responsible for crustal movements and therefore it is the principal architect for constructing the environments (e.g. shallow marine, continental, etc.) wherein life developed and flourished. Heat flow has also influenced the movements of volatile elements (e.g. C, N, H, S, rare gases, etc.) both within the Earth's crust and between the crust and mantle. The inventory of these elements in the Earth's crust is important, not just because some of them constitute the building blocks of organic matter, but also because they influence the biosphere's climate. The purpose of this work is to evaluate how the decline of heat flow over the course of the Earth's history has influenced the carbon inventory in the Earth's crust. Such an evaluation must first consider whether the rate at which carbon is presently being exchanged between the mantle and crust is sufficient to play an important role in controlling the crustal inventory. Secondly, this exchange of carbon must be reevaluated in the context of the Precambrian Earth's environment. One very important consideration is that the upper mantle was perhaps 300 C hotter 3 b.y. ago than it is today. Author

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**USE OF LABORATORY SIMULATED PYROLYSIS IN TRACING THE HISTORY OF SEDIMENTARY ORGANIC MATTER**

I. R. KAPLAN, E. TANNENBAUM, and B. E. HUIZINGA *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 82 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Results from laboratory simulated pyrolyses experiments show that in addition to depth of burial, preservation of kerogen, and hence any morphologic structure in it, is also dependent on the mineral matrix with which it is associated. In the presence of clay minerals, and especially under dry conditions, extractable lipids released during kerogen decomposition are more rapidly destroyed than in the presence of calcite or chert matrices. The result is production of gas, polar bitumen and pyrobitumen and destruction of biomarkers. During such an early reorganization of the kerogen, the biomarker constituents can be destroyed, or unrecognizably altered. The above process of organic residues maturation appears to be inhibited in the presence of water and is significantly reduced where kerogen is hosted in limestones, dolomites or cherts. These minerals have been characteristically found to be the most reliable in yielding morphological fossils and small quantities of extractable bitumen in Archean and Proterozoic rocks. To understand the validity of chemical and morphological fossils, in the early geologic record, it will be necessary to understand the process of kerogen in sedimentary rocks. To test the role of various minerals on the preservation process, kerogen extracted from a variety of rocks has been heated together with montmorillonite, illite and calcite. The kinetics of the process has been monitored and the products quantitatively identified. M.G.

**N86-26885\*#** Indiana Univ., Bloomington. Biogeochemical Labs.

**ISOTOPIC, PETROLOGIC AND BIOGEOCHEMICAL INVESTIGATIONS OF BANDED IRON-FORMATIONS**

J. M. HAYES, A. J. KAUFMAN, C. KLEIN (New Mexico Univ., Albuquerque), S. A. STUDLEY, M. E. BAUR (California Univ., Los Angeles), and M. R. WALTER (Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia) /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 84 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

It is recognized that the first occurrence of banded iron-formations (BIFs) clearly predates biological oxygenation of the atmosphere-hydrosphere system and that their last occurrences extend beyond plausible dates of pervasive biological oxygenation. For this reason, and because enormous quantities of oxidizing power have been sequestered in them, it is widely thought that these massive, but enigmatic, sediments must encode information about the mechanism and timing of the rise of atmospheric O<sub>2</sub>. By coupling isotopic analyses of iron-formation carbonates with biogeochemical and petrologic investigations, we are studying (1) the mechanism of initial sedimentation of iron; (2) the role of iron in microbially mediated diagenetic processes in fresh iron-formation sediments; and (3) the logical integration of mechanisms of deposition with observed levels of banding. Thus far, it has been shown that (1) carbonates in BIFs of the Hamersley Group of Western Australia are isotopically inhomogeneous; (2) the nature and pattern of isotopic ordering is not consistent with a metamorphic origin for the overall depletion of C-13 observed in the carbonates; (3) if biological, the origin of the C-13 depleted carbonate could be either respiratory or fermentative; (4) iron may have been precipitated as Fe(3+), then reduced to Fe(2+) within the sediment; and (5) sedimentary biogeochemical systems may have been at least partially closed to mass transport of carbonate species.

Author

**N86-26886\*#** Michigan Univ., Ann Arbor.

**THE LUNAR NODAL TIDE AND THE DISTANCE TO THE MOON DURING THE PRECAMBRIAN ERA**

J. C. G. WALKER and K. J. ZAHNLE /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 85 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The origin and early evolution of life on Earth occurred under physical and chemical conditions distinctly different from those of the present day. The broad goal of this research program is to characterize these conditions. One aspect involves the dynamics of the Earth-Moon system, the distance of the Moon from the Earth, and the length of the day. These have evolved during the course of Earth history as a result of the dissipation of tidal energy. As the moon has receded the amplitude of oceanic tides has decreased while the increasing length of the day should have influenced climate and the circulation of atmosphere and ocean. A 23.3 year periodicity preserved in a 2500 million year old banded iron-formation was interpreted as reflecting the climatic influence of the lunar nodal tide. The corresponding lunar distance would then have been approx. 52 Earth radii. The influence of the lunar nodal tide is also apparent in rocks with an age of 680 million years B.P. The derived value for lunar distance 2500 million years ago is the only datum on the dynamics of the Earth-Moon system during the Precambrian era of Earth history. The implied development of Precambrian tidal friction is in accord with more recent paleontological evidence as well as the long term stability of the lunar orbit.

Author

**N86-26887\*#** California Univ., Los Angeles. Dept. of Earth and Space Sciences.

**RECENT PROGRESS IN PRECAMBRIAN PALEOBIOLOGY**

J. W. SCHOPF /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 87 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Ongoing studies at UCLA include the following: (1) investigations in Archean and Proterozoic sequences of various locations; (2) laboratory and field studies of modern microbial biocoenoses (analogues of Precambrian microbial communities) especially those at Laguna Mormona, Baja California, Mexico; (3) development of new laboratory techniques for the separation and concentration of minute cellularly preserved fossils for isotopic and organic geochemical analyses; and (4) assembly of a computerized database for assessment of the timing and nature of major events occurring during Precambrian biotic evolution, and of the potential applicability of ancient microbiotas to problems of global biostratigraphy and biogeography.

Author

**N86-26888\*#** Illinois Univ., Urbana.

**HIGHER-ORDER STRUCTURE OF RRNA**

R. R. GUTELL and C. R. WOESE /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 88 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

A comparative search for phylogenetically covarying basepair replacements within potential helices has been the only reliable method to determine the correct secondary structure of the 3 rRNAs, 5S, 16S, and 23S. The analysis of 16S from a wide phylogenetic spectrum, that includes various branches of the eubacteria, archaebacteria, eucaryotes, in addition to the mitochondria and chloroplast, is beginning to reveal the constraints on the secondary structures of these rRNAs. Based on the success of this analysis, and the assumption that higher order structure will also be phylogenetically conserved, a comparative search was initiated for positions that show co-variation not involved in secondary structure helices. From a list of potential higher order interactions within 16S rRNA, two higher-order interactions are presented. The first of these interactions involves positions 570 and 866. Based on the extent of phylogenetic covariation between these positions while maintaining Watson-Crick pairing, this higher-order interaction is considered proven. The other interaction involves a minimum of six positions between the 1400 and 1500 regions of the 16S rRNA. Although these patterns of covariation are not as striking as the 570/866 interaction, the fact that they all exist in an anti-parallel fashion and that experimental methods previously implicated these two regions of the molecule in tRNA function suggests that these interactions be given serious consideration.

Author

**N86-26889\*#** Houston Univ., Tex. Dept. of Biochemical Sciences.

**THE RRNA EVOLUTION AND PROCARYOTIC PHYLOGENY**

G. E. FOX /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 89 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Studies of ribosomal RNA primary structure allow reconstruction of phylogenetic trees for prokaryotic organisms. Such studies reveal major dichotomy among the bacteria that separates them into eubacteria and archaebacteria. Both groupings are further segmented into several major divisions. The results obtained from 5S rRNA sequences are essentially the same as those obtained with the 16S rRNA data. In the case of Gram negative bacteria the ribosomal RNA sequencing results can also be directly compared with hybridization studies and cytochrome c sequencing studies. There is again excellent agreement among the several methods. It seems likely then that the overall picture of microbial phylogeny that is emerging from the RNA sequence studies is a good approximation of the true history of these organisms. The RNA data allow examination of the evolutionary process in a semi-quantitative way. The secondary structures of these RNAs are largely established. As a result it is possible to recognize



examples of local structural evolution. Evolutionary pathways accounting for these events can be proposed and their probability can be assessed. Author

**N86-26890\*#** California Univ., Berkeley. Space Sciences Lab. **INVESTIGATIONS WITH METHANOBACTERIA AND WITH EVOLUTION OF THE GENETIC CODE**

T. H. JUKES /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 90 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

*Mycoplasma capricolum* was found by Osawa et al. to use UGA as the code of tryptophan and to contain 75% A + T in its DNA. This change could have been from evolutionary pressure to replace C + G by A + T. Numerous studies have been reported of evolution of proteins as measured by amino acid replacements that are observed when homologous proteins, such as hemoglobins from various vertebrates, are compared. These replacements result from nucleotide substitutions in amino acid codons in the corresponding genes. Simultaneously, silent nucleotide substitutions take place that can be studied when sequences of the genes are compared. These silent evolutionary changes take place mostly in third positions of codons. Two types of nucleotide substitutions are recognized: pyrimidine-pyrimidine and purine-purine interchanges (transitions) and pyrimidine-purine interchanges (transversions). Silent transitions are favored when a corresponding transversion would produce an amino acid replacement. Conversely, silent transversions are favored by probability when transitions and transversions will both be silent. Extensive examples of these situations have been found in protein genes, and it is evident that transversions in silent positions predominate in family boxes in most of the examples studied. In associated research a streptomycete from cow manure was found to produce an extracellular enzyme capable of lysing the pseudomurein-containing methanogen *Methanobacterium formicicum*. Author

**N86-26891\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**IS THE ATPASE FROM HALOBACTERIUM SACCHAROVORUM AN EVOLUTIONARY RELIC?**

L. I. HOCHSTEIN, W. ALTEKAR (Bhabha Research Center (India).), and H. KRISTJANSSON /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 91 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The ATP Synthase Complex present in the membranes of mitochondria, chloroplasts or bacteria is composed of 2 sectors: FO, an integral membrane protein consisting of 3 subunits mediating proton translocation across the membrane and F1, the catalytic component composed of 5 non-identical subunits. The apparent early origin of the ATP Synthase Complex, as implied by its ubiquitous distribution, seems inconsistent with its structural and functional complexity and raises the question if simpler versions of the ATP Synthase exist. Such an ATP Synthase has been searched for in various Archaeobacteria. A purified halobacterial ATPase activity which possesses certain properties consistent with those of an ATP Synthase but which has a different subunit structure is described. M.G.

**N86-26892\*#** California Univ., Irvine. **FUNCTIONAL AND EVOLUTIONARY RELATIONSHIPS BETWEEN BACTERIORHODOPSIN AND HALORHODOPSIN IN THE ARCHAEABACTERIUM, HALOBACTERIUM HALOBIVM**

J. K. LANYI /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 92 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The archaeobacteria occupy a unique place in phylogenetic trees constructed from analyses of sequences from key informational macromolecules, and their study continues to yield interesting ideas on the early evolution and divergence of biological forms. It is now known that the halobacteria among these species contain

various retinal-proteins, resembling eukaryotic rhodopsins, but with different functions. Two of these pigments, located in the cytoplasmic membranes of the bacteria, are bacteriorhodopsin (a light-driven proton pump) and halorhodopsin (a light-driven chloride pump). Comparison of these systems is expected to reveal structure/function relationships in these simple (primitive?) energy transducing membrane components and evolutionary relationships which had produced the structural features which allow the divergent functions. Findings indicate that very different primary structures are needed for these proteins to accomplish their different functions. Indeed, analysis of partial amino acid sequences from halo-opsin shows already that few if any long segments exist which are homologous to bacterio-opsin. Either these proteins diverged a very long time ago to allow for the observed differences, or the evolutionary clock in the halobacteria runs faster than usual. M.G.

**N86-26893\*#** California Univ., Berkeley. Div. of Molecular Plant Biology.

**THIOREDOXINS IN EVOLUTIONARILY PRIMITIVE ORGANISMS**

B. B. BUCHANAN /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 93 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Thioredoxins are low molecular weight redox proteins, alternating between the S-S (oxidized) and SH (reduced) states, that function in a number of biochemical processes, including DNA synthesis, DNA replication, and enzyme regulation. Until recently, reduced ferredoxin was known to serve as the source of reducing power for the reduction of thioredoxins only in oxygenic photosynthetic cells. In all other organisms, the source of hydrogen (electrons) for thioredoxin reduction was considered to be NADPH. It was found that *Clostridium pasteurianum*, an anaerobic organism normally living in the soil unexposed to light, resembles photosynthetic cells in using ferredoxin for the reduction of thioredoxin. The results reveal the existence of a pathway in which ferredoxin, provides the reducing power for the reduction of thioredoxin via the flavoprotein enzyme, ferredoxin:thioredoxin reductase. In related studies, it was found that *Chromatium vinosum*, an anaerobic photosynthetic purple sulfur bacterium, resembles evolutionarily more advanced micro-organisms in having an NADP-thioredoxin system composed of a single thioredoxin which is reduced by NADPH via NADP-thioredoxin reductase. The adoption of the NADP-thioredoxin system by *Chromatium* seems appropriate in view of evidence that the organism utilizes ATP-driven reverse electron transport. Finally, results of research directed towards the identification of target enzymes of the ferredoxin/thioredoxin system in a cyanobacterium (*Nostoc muscorum*), show that thioredoxin-linked photosynthetic enzymes of cyanobacteria are similar to those of chloroplasts. It now seems that the ferredoxin/thioredoxin system functions in regulating CO<sub>2</sub> assimilation via the reductive pentose phosphate cycle in oxygenic but not anoxygenic photosynthetic cells. M.G.

**N86-26894\*#** Rockefeller Univ., New York.

**BIOSYNTHETIC PORPHYRINS AND THE ORIGIN OF PHOTOSYNTHESIS**

D. MAUZERALL, A. LEY, and J. A. MERCER-SMITH (Los Alamos National Lab., N. Mex.) /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 94 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Since the prebiotic atmosphere was anaerobic, if not reducing, a useful function of primordial photosynthesis would have been to photooxidize reduced substrates such as Fe(+2), S(-2) or reduced organic molecules and to emit hydrogen. Experiments have shown that the early biogenic pigments uroporphyrin and coproporphyrin do photooxidize organic compounds and emit hydrogen in the presence of a platinum catalyst. These experiments were carried out in dilute aqueous solution near neutral pH under anaerobic atmosphere, and quantum yields near 10<sup>-2</sup> were obtained. Thus relevant prebiotic conditions were maintained. Rather than to further

optimize conditions, attempts were made to replace the platinum catalyst by a more prebiotically suitable catalyst. Trials with an Fe<sub>4</sub>S<sub>4</sub>(SR)<sub>4</sub> cluster, in analogy to the present hydrogenase and nitrogenase, were not successful. However, experiments using cobalt complexes to catalyze the formation of hydrogen are promising. In analogy with biological photosynthetic systems which group pigments, electron transfer molecules and enzymes in clusters for efficiency, it was found that binding the biogenic porphyrins to the polyvinyl alcohol used to support the platinum catalyst did increase the quantum yield of the reaction. It was also found that ultraviolet light can serve to photo-oxidize porphyrinogens to porphyrins under anaerobic conditions. Thus the formation of the colorless porphyrinogens by the extraordinarily simple biosynthetic pathway would not be a problem because of the prevalence of UV light in the prebiotic, anoxic atmosphere.

Author

**N86-26895\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**OXYGEN AND THE EVOLUTION OF METABOLIC PATHWAYS**  
L. L. JAHNKE *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 95 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

While a considerable amount of evidence has been accumulated about the history of oxygen on this planet, little is known about the relative amounts to which primitive cells might have been exposed. One clue may be found in the metabolic pathways of extant microorganisms. While eucaryotes are principally aerobic organisms, a number are capable of anaerobic growth by fermentation. One such eucaryotic microorganism, *Saccharomyces cerevisiae*, will grow in the complete absence of oxygen when supplemented with unsaturated fatty acid and sterol. Oxygen-requiring enzymes are involved in the synthesis of both of these compounds. Studies have demonstrated that the oxidative desaturation of palmitic acid and the conversion of squalene to sterols occur in the range of 10<sup>-3</sup> to 10<sup>-2</sup> PAL. Thus, if the oxygen requirements of these enzymatic processes are an indication, eucaryotes might be more primitive than anticipated from the microfossil record. Results of studies on the oxygen requirements for sterol and unsaturated fatty acid synthesis in a more primitive procaryotic system are also discussed. M.G.

**N86-26896\*#** California Univ., San Diego, La Jolla.  
**EVOLUTION OF THIOL PROTECTIVE SYSTEMS IN PROKARYOTES**

R. C. FAHEY and G. L. NEWTON *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 96 May 1986

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Biological thiols are essential elements in most aspects of cell function but undergo rapid oxidation to disulfides in the presence of oxygen. The evolution of systems to protect against such oxygen toxicity was essential to the emergence of aerobic life. The protection system used by eukaryotes is based upon glutathione (GSH) and GSH-dependent enzymes but many bacteria lack GSH and apparently use other mechanisms. The objective of this research is to elaborate the thiol protective mechanisms employed by prokaryotes of widely divergent evolutionary origin and to understand why GSH became the central thiol employed in essentially all higher organisms. Thiol-selective fluorescent labeling and HPLC analysis has been used to determine key monothiol components. M.G.

**N86-26897\*#** Florida State Univ., Tallahassee. Dept. of Biological Science.

**MICROFOSSILS IN THE ANTARCTIC COLD DESERT: POSSIBLE IMPLICATIONS FOR MARS**

E. I. FRIEDMANN and R. OCAMPO-FRIEDMANN (Florida Agricultural and Mechanical Univ., Tallahassee) *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 97 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

In the Ross Desert of Antarctica, the principal life form is the cryptoendolithic microbial community in the near-surface layers of porous sandstone rocks. Biological, geological, and climatic factors interact in a complex and precarious balance, making life possible in an otherwise hostile environment. Once this balance is tipped, fossilization sets in. In the reverse case, new colonization of the rock surface may be initiated. As a result, fossilization is contemporary with modern life and both may be simultaneously present in a mosaic pattern. Also, different stages of fossilization are present. The process of fossilization takes place in a nonaquatic environment. If primitive life ever appeared on Mars, it is possible that with increasing aridity, life withdrew into an endolithic niche similar to that in the Antarctic desert. Fossilization in a nonaquatic environment may have set in with the result that traces of past life could be preserved. If such was the case, the study of the fossilization process in Antarctica may hold useful information for the analysis of Martian samples for microfossils. Author

**N86-26898\*#** University of Southern Illinois, Carbondale.  
**EVOLUTIONARY SIGNIFICANCE OF OSMOREGULATORY MECHANISMS IN CYANOBACTERIA**

J. H. YOPP, J. H. PAVLICEK, and M. H. SIBLEY *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 98 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Physiological processes of all life forms on this planet are intrinsically related to their intracellular water potential. The overall goal was the elucidation of the mechanism(s) whereby the first oxygenic photoautotrophs (the cyanobacteria) adjust their water potential to that of a changing external water potential (that is, osmoregulate). Osmoregulation is achieved by intracellular adjustment of inorganic and/or organic solutes (osmolytes) involving specific biochemical mechanisms. Structural and biochemical evolution within the cyanobacteria is believed completed (and fixed in present day forms) by the end of the Precambrian eon. Therefore, research using cyanobacteria of all three structural types (unicellular, filamentous, and branched), each grown in the photoautotrophic (PA), photoheterotrophic (PG), and chemotrophic (CH) modes of nutrition, should provide insight into the origin and evolution of the photosynthetically related osmoregulatory mechanisms of eukaryotic organisms. The chloroplasts of these organisms are phylogenetically related to the cyanobacteria. Author

**N86-26899\*#** Boston Univ., Mass.  
**MICROBIAL CONTRIBUTIONS TO THE PRECAMBRIAN EARTH**

L. MARGULIS, D. BERMUDEZ, and R. OBAR *In* NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 99 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Life has existed on Earth for approximately 3.5 billion years. For most of this time, prokaryotic communities provided the major biological forces changing the Earth. Many changes in atmospheric gas composition occurred during the Archean and Proterozoic eons as a result of microbial activity. Extant microbial communities were used to help understand the dynamics which contributed to these atmospheric changes. The microbial mat communities were characterized according to the organismic constituents. Symbiosis in microbial communities is recognized as a major force in cell evolution. Among the evolutionary enigmas investigated is the problem of the origin of the undulipodia. Undulipodial microtubules are still deployed for major cellular processes such as mitosis and meiosis. Several prokaryotes were tested for the presence of



the S1-type protein, so far only spirochetes were found to possess it. The S1-type protein is being sought in cyanobacteria reported to contain microtubules. B.G.

**N86-26900\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**ORGANIC S13C VALUES VARY SLIGHTLY WITH SALINITY IN MICROBIAL MATS AT GUERRERO NEGRO, BAJA CALIFORNIA SUR, MEXICO: IMPLICATIONS FOR STROMATOLITE S13C VALUES**

D. J. DESMARAIS, E. PETERSON, E. KWONG, and H. BUI / In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 100 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Stromatolites, layered sedimentary rock structures produced by communities of microorganisms, constitute the most abundant early evidence of life on Earth. Microbial mats, which are found most frequently in hypersaline marine or hot spring environments, serve as useful modern analogs of stromatolitic communities. Biochemical studies of mats were conducted to assist in the interpretations of stromatolites. The data suggest that salinity effects are insufficient by themselves to cause the C-13 differences observed between Precambrian stromatolites and modern microbial mats. Author

**N86-26901\*#** Chicago Univ., Ill.

**THE FOSSIL RECORD OF EVOLUTION: ANALYSIS OF EXTINCTION**

D. M. RAUP / In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 102 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

There is increasing evidence that events in space have had direct effects on Earth history and on the history of life on Earth. Nowhere is this more evident than in mass extinction. The biosphere has undergone repeated devastation caused by relatively short-lived environmental stress, with species kill rates up to 80 and 95%. For five of the mass extinctions, geochemical or other evidence was reported suggesting large body impact as the cause of the environmental stress producing the extinctions. It was argued on statistical ground that the major extinction events are uniformly periodic in geological time. If it is true that large body impact is a principal cause of mass extinctions and if the periodicity is real, then a cosmic driving mechanism is inescapable. Paleontological data sets were developed which detail the ranges in geological time of about 4,000 families and 25,000 genera of fossil marine organisms. Analyses to date have concentrated on the most recent 250 million years. Associated with these studies are analyses of other aspects of Earth history which may have signatures indicative of extraterrestrial effects. Author

**N86-26902\*#** Chicago Univ., Ill.

**THE FOSSIL RECORD OF EVOLUTION: DATA ON DIVERSIFICATION AND EXTINCTION**

J. J. SEPKOSKI, JR. / In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 102 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Synoptic studies of the fossil record of complex life on Earth indicate increasingly that extinction, and especially mass extinction, were extremely important driving forces in the history of life. Analysis of a new compilation of geologic ranges for 25,000 genera of marine animals suggests that extinction events were much more frequent in occurrence and variable in magnitude than previously suspected. At least 30 well documented and potential mass extinctions were identified in the dataset. The most recent event, distributed over 260 to 0 ma. exhibit a stationary periodicity of  $26.1 \pm 1$  ma, implicating a cosmological forcing mechanism. Earlier events, especially in the 575 to 450 ma interval, are more frequent, possibly indicating either a breakdown of periodicity in the more distant past; and as yet undemonstrated diminution of the period length; or frequent aperiodic terrestrial perturbations of a less stable biota superimposed upon the cosmological periodicity. Author

**N86-26903\*#** California Univ., Berkeley. Lawrence Berkeley Lab.

**GEOCHEMICAL ANOMALIES, BOLIDE IMPACTS AND BIOLOGICAL EXTINCTIONS ON THE EARTH**

F. ASARO, L. W. ALVAREZ, H. V. MICHEL, and W. ALVAREZ (California Univ., Berkeley.) / In NASA, Washington Second Symposium in Chemical Evolution and the Origin and Evolution of Life p 104 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Geochemical and mineralogical techniques are used to search for evidence of extraterrestrial impacts associated with mass and lesser biological extinction peaks in the geological record. Studies of the Cretaceous-Tertiary boundary serve as a baseline for evaluating geochemical data from the extinction horizons. Other studies were generally concentrated on rock strata corresponding to the periodic extinction peaks noted by Raup and Sepkoski. A significant iridium anomaly in late Eocene marine sediments associated with extinctions of radiolaria in low latitudes and attributed to an extraterrestrial source is widely distributed in 8 to 9 sites around the world. Author

**N86-26904\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**CLIMATIC CONSEQUENCES OF VERY HIGH CO2 LEVELS IN EARTH'S EARLY ATMOSPHERE**

J. F. KATSING / In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 105 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Earth has approximately 60 bars of carbon dioxide tied up in carbonate rocks, or roughly 2/3 the amount of CO<sub>2</sub> of the atmosphere of Venus. Two different lines of evidence, one based on thermodynamics and the other on geochemical cycles, indicate that a substantial fraction of the CO<sub>2</sub> may have resided in the atmosphere during the first few hundred million years of the Earth's history. A natural question which arises is whether this much CO<sub>2</sub> would have resulted in a runaway greenhouse effect. One dimensional radiative/convective model calculations presented showed that the surface temperature of a hypothetical primitive atmosphere containing 20 bars of CO<sub>2</sub> was less than 100 C; thus no runaway greenhouse effect would have occurred. The climatic stability of the early atmosphere is a consequence of three factors: reduced solar luminosity at that time, an increase in planetary albedo caused by Rayleigh scattering by CO<sub>2</sub>, and the stabilizing effects of a moist convection. The latter two factors are sufficient to prevent a CO<sub>2</sub> induced runaway greenhouse effect on the present Earth as well, for CO<sub>2</sub> levels up to 100 bars. Further studies are being undertaken to determine whether a runaway greenhouse effect could have occurred during the latter stages of the accretion process and, if so, whether it would have collapsed one the influx of material slowed down. Author

**N86-26905\*#** Ohio State Univ., Columbus.

**A DECADE OF SETI OBSERVATIONS**

R. S. DIXON / In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 107 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

A full time dedicated search for extraterrestrial radio signals of intelligent origin has been in progress at the Ohio State University Radio Observatory since 1973. The radio telescope has a collecting area of 2200 square meters, which is equivalent to a circular dish 175 feet in diameter. The search concentrates on a 500 kHz bandwidth centered on the 1420 MHz hydrogen line, Doppler corrected to the galactic standard of rest. A large portion of the sky visible from Ohio was searched, with particular emphasis on the galactic center region and the M31 Andromeda galaxy. The survey is largely computer automated, and all data reduction is done in real time. Two distinct populations of signals were detected. The first is a relatively small number of signals which persist for over a minute and which are clearly extraterrestrial in origin. The second is the large number of signals which persist less than 10 seconds whose locations are anticorrelated with the galactic plane

but show clumps along the galactic axis. None of these signals were observed to recur, despite repeated observations. The cause of these signals were not determined. Author

**N86-26906\*#** California Univ., Berkeley. Space Sciences Lab.

**THE BERKELEY SERENDIP PROJECT**

S. BOWYER, D. WERTHIMER, J. TARTER, and R. BUHSE /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 108 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

An automated system was designed to perform a real time search for narrow band radio signals in the spectra of sources in a regularly scheduled, non-SETI astronomical observing program. The system will compute the power spectrum using a 65,536 channel fast Fourier transform processor with a real time bandwidth of 128 KHz and 2 Hz per channel resolution. After search for peaks in a 100 KHz portion of the IF band of the radio telescope, the system will move to the next 100 KHz portion using a programmable frequency synthesizer. When the whole IF band is scanned, the process will start again. Unidentified peaks in the power spectra are candidates for further study and their celestial coordinates will be recorded along with the time and power, IF and RF frequency, and bandwidth of the peak. Most of the hardware was developed and the machine software is in the process of being finalized. A number of means for identifying and rejecting power spectra peaks which have a high likelihood of being nonuseful are being investigated. Author

**N86-26907\*#** California Univ., Berkeley. Space Sciences Lab.  
**AN INFRARED SEARCH FOR EXTRATERRESTRIAL LASER SIGNALS**

A. BETZ /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 109 May 1986  
Avail: NTIS HC A07/MF A01 CSCL 06C

The focus of project SETI is on microwave frequencies, where receivers fundamentally have the best sensitivity for the detection of narrow band signals. Such receivers, when coupled to existing radio telescopes, form an optimum system for broad area searches over the sky. Detection of narrow band infrared signals is best done with a laser heterodyne receiver similar in function to a microwave spectral line receiver. A receiver was built for astrophysical observations at 30 THz (10 microns) and the spectrometer is being adapted for SETI work. The receiver uses a small CO<sub>2</sub> laser as the local oscillator, a HgCdTe diode as the photomixer, and a multichannel intermediate frequency (IF) filterbank. An advanced multichannel IF processor is now being built to detect infrared line radiation in 1000 spectral channels each 1 MHz wide. When completed this processor will be used with a ground based telescope next year for a survey of several hundred selected stars for narrow band CO<sub>2</sub> laser signals at 30 THz. Author

**N86-26908\*#** Boston Univ., Mass. Dept. of Astronomy.  
**USING THE IRAS DATA TO SEARCH IN THE ASTEROID BELT FOR ANY POTENTIAL EVIDENCE OF GALACTIC COLONIZATION**

M. D. PAPAGIANNIS /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 110 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The end product of the biological evolution seems to be the appearance of technological civilizations, which are characterized by superior technology that supercedes biological capabilities. The Search for Extraterrestrial Intelligence (SETI) has gained scientific recognition in recent years. The concept of galactic colonization is debated extensively, with opinions ranging from the impossible to the inevitable, but without a clear resolution. Answers can be obtained only with experimental tests and not with endless debates. A search for large space colonies in the asteroid belt, an ideal source of raw materials for a spaceborne civilization, is a test of the galactic colonization theory. The catalogue of solar system objects obtained from the Infrared Astronomy Satellite (IRAS) observations at 12, 25, 60, and 100 microns, is an ideal source

for such a search. The catalog is expected to be ready at the end of 1985 and will contain more than 10,000 objects. B.G.

**N86-26909\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**OVERVIEW OF THE NASA SETI PROGRAM**

B. M. OLIVER /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 111 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The NASA Search of Extraterrestrial Intelligence (SETI) program plan is to scan the microwave window from 1 to 10 GHz with existing radio telescopes and sophisticated signal processing equipment looking for narrow band features that might represent artificial signals. A microwave spectrometer was built and is being field tested. A pattern recognition computer to search for drifting continuous wave signals and pulse trains in the output spectra is being designed. Equipment to characterize the radio frequency interference environment was also built. The plan is to complete the hardware and software by FY-88. Then, with increased funding, this equipment will be replicated in Very Large Scale Integration form. Observations, both a complete sky survey and a search for nearby solar type stars, will begin in about 1990. The hypothesis that very powerful signals exist or that signals are being beamed at us will be tested. To detect the kinds of signals radiated at distances of 100 light years will require a collecting area kilometers in diameter. Author

**N86-26910\*#** Stanford Univ., Calif. Radioscience Lab.

**STANFORD HARDWARE DEVELOPMENT PROGRAM**

A. PETERSON, I. LINSKOTT, and J. BURR /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 112 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

Architectures for high performance, digital signal processing, particularly for high resolution, wide band spectrum analysis were developed. These developments are intended to provide instrumentation for NASA's Search for Extraterrestrial Intelligence (SETI) program. The real time signal processing is both formal and experimental. The efficient organization and optimal scheduling of signal processing algorithms were investigated. The work is complemented by efforts in processor architecture design and implementation. A high resolution, multichannel spectrometer that incorporates special purpose microcoded signal processors is being tested. A general purpose signal processor for the data from the multichannel spectrometer was designed to function as the processing element in a highly concurrent machine. The processor performance required for the spectrometer is in the range of 1000 to 10,000 million instructions per second (MIPS). Multiple node processor configurations, where each node performs at 100 MIPS, are sought. The nodes are microprogrammable and are interconnected through a network with high bandwidth for neighboring nodes, and medium bandwidth for nodes at larger distance. The implementation of both the current multichannel spectrometer and the signal processor as Very Large Scale Integration CMOS chip sets was commenced. Author

**N86-26911\*#** California Univ., Berkeley. Dept. of Astronomy.

**GOLDSTONE FIELD TEST ACTIVITIES: TARGET SEARCH**

J. TARTER /in NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 113 May 1986 Prepared in cooperation with Search for Extraterrestrial Intelligence Inst., Los Altos, Calif.

Avail: NTIS HC A07/MF A01 CSCL 06C

In March of this year prototype SETI equipment was installed at DSS13, the 26 meter research and development antenna at NASA's Goldstone complex of satellite tracking dishes. The SETI equipment will remain at this site at least through the end of the summer so that the hardware and software developed for signal detection and recognition can be fully tested in a dynamic observatory environment. The field tests are expected to help understand which strategies for observing and which signal recognition algorithms perform best in the presence of strong

man-made interfering signals (RFI) and natural astronomical sources. Author

**N86-26912\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**GOLDSTONE FIELD TEST ACTIVITIES: SKY SURVEY**

S. GULKIS and E. T. OLSEN /In NASA, Washington Second Symposium on Chemical Evolution and the Origin and Evolution of Life p 114 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The goals are to conduct a research and development program aimed at determining the most effective way to do SETI within the constraints of current technology and estimated budgets. The general search strategy adopted is that which is recommended by the SETI Science Working Group. The strategy for an all sky survey for SETI was further developed over the last year. Scan patterns, scan rates, and signal detection algorithms were developed. Spectral power measurement instrumentation was tested at the Venus Station of the Goldstone Deep Space Communication Complex. A specially designed radio frequency interference (RFI) measurement system was built and installed at the Venus Station. A data base management system for storage and retrieval of the RFI data was partially implemented on a VAX 750 computer at the Jet Propulsion Laboratory. Author

**N86-26913#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**JPL'S ROLE IN THE SETI PROGRAM**

M. J. KLEIN /In NASA, Washington Second Symposium on Chemical Evolution and the Origin of Life p 115 May 1986

Avail: NTIS HC A07/MF A01 CSCL 06C

The goal of the JPL SETI Team is to develop the strategies and the instrumentation required to carry out an effective, yet affordable, SETI Microwave Observing Program. The primary responsibility for JPL is the development and implementation of the Sky Survey component of the bimodal search program recommended by the SETI Science Working Group (NASA Technical Paper 2244, 1983). JPL is also responsible for the design and implementation of microwave analog instrumentation (including antenna feed systems, low noise RF amplifiers, antenna monitor and control interfaces, etc.) to cover the microwave window for the Sky Survey and the Target Search observations. The primary site for the current SETI Field Test activity is the Venus Station of the Goldstone Deep Space Communication Complex. A SETI controller was constructed and installed so that pre-programmed and real time SETI monitor and control data can be sent to and from the station controller. This unit will be interfaced with the MCSA. A SETI Hardware Handbook was prepared to describe the various systems that will be used by the project at the Venus Station; the handbook is frequently being expanded and updated. The 65,000 channel FFT Spectrum analyzer in the RFI Surveillance System was modified to permit operation with variable resolutions (300 Hz to less than 1 Hz) and with real-time accumulation, which will enhance the capability of the system for testing Sky Survey search strategies and signal detection algorithms. Author

**N86-27152\*#** National Aeronautics and Space Administration, Washington, D.C.

**EXO BIOLOGY EXPERIMENT CONCEPTS FOR SPACE STATION**

L. D. GRIFFITHS (Management and Technical Services Co., Washington, D.C.) and D. L. DEVINCENZI /In NASA, Lyndon B. Johnson Space Center Space Station Planetology Experiments (SSPEX) 1 p May 1986

Avail: NTIS HC A05/MF A01 CSCL 03A

The exobiology discipline uses ground based and space flight resources to conduct a multidiscipline research effort dedicated to understanding fundamental questions about the origin, evolution, and distribution of life and life related molecules throughout the universe. Achievement of this understanding requires a methodical research strategy which traces the history of the biogenic elements from their origins in stellar formation processes through the chemical evolution of molecules essential for life to the origin and

evolution of primitive and, ultimately, complex living species. Implementation of this strategy requires the collection and integration of data from solar system exploration spacecraft and ground based and orbiting observatories and laboratories. The Science Lab Module (SLM) of the Space Station orbiting complex may provide an ideal setting in which to perform certain classes of experiments which form the cornerstone of exobiology research. These experiments could demonstrate the pathways and processes by which biomolecules are synthesized under conditions that simulate the primitive Earth, planetary atmospheres, cometary ices, and interstellar dust grains. Exobiology experiments proposed for the Space Station generally fall into four classes: interactions among gases and grains (nucleation, accretion, gas-grain reactions), high energy chemistry for the production of biomolecules, physical and chemical processes occurring on an artificial comet, and tests of the theory of panspermia. Author

**N86-27923#** Southwest Research Inst., San Antonio, Tex. Dept. of Bioengineering.

**EFFECTS OF 60 HZ ELECTRIC FIELDS ON OPERANT AND SOCIAL STRESS BEHAVIORS OF NONHUMAN PRIMATES**

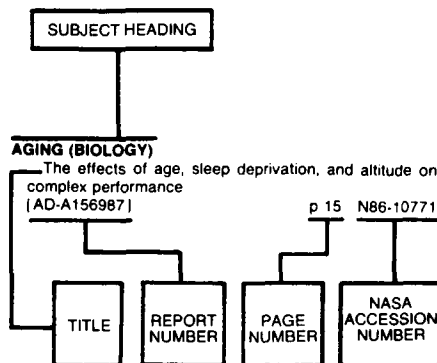
W. R. ROGERS, J. H. LUCAS, G. T. MOORE, and J. L. ORR 1985 18 p Presented at the DOE Contractors Conference, Alexandria, Va., 5 Nov. 1985

(Contract DE-AC02-80RA-50219)

(DE86-003748; CONF-8511143-1) Avail: NTIS HC A02/MF A01

An overall description of this research program is presented. The objectives are to investigate the use of nonhuman primates to investigate possible behavioral effects associated with exposure to high-intensity, 60 Hz, electric fields. DOE

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The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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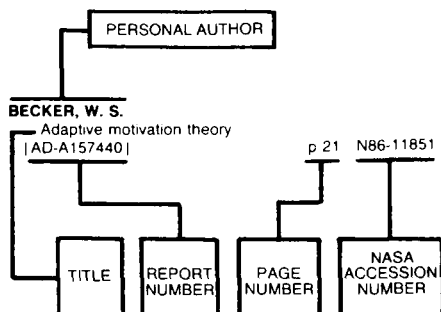
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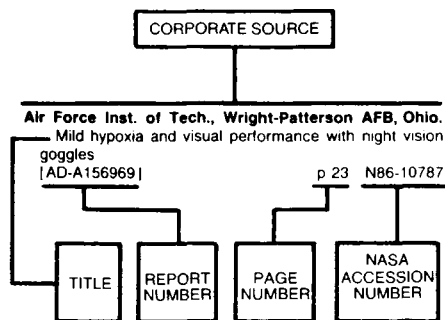
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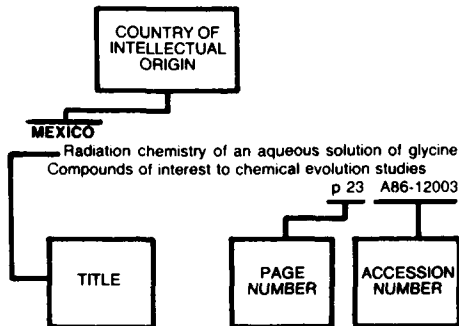
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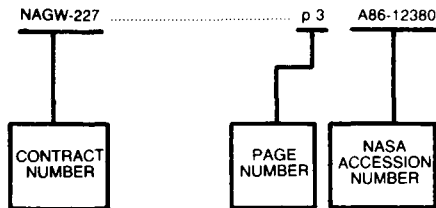
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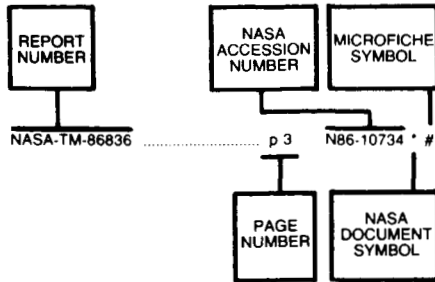
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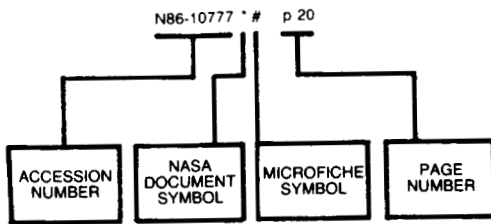
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